Secondary Course

212 - Science and Technology

Laboratory Manual

Course Coordinators
Ms. Neelam Gupta
Dr. Alok Kumar Gupta
Dr. Rajeev Prasad

Project Coordinator (AEP)
Ms. Asheema Singh

विद्याधनम् सर्वधनं प्रधानम्

NATIONAL INSTITUTE OF OPEN SCHOOLING
(An autonomous organisation under MHRD, Govt. of India)
A-24-25, Institutional Area, Sector-62, NOIDA-201309 (U.P.)
Website: www.nios.ac.in, Toll Free No. 18001809393

August, 2012 (25,000 Copies)

Published by the Secretary, National Institute of Open Schooling, A-24-25, Institutional Area, Sector- 62, Noida-201309 and printed at M/s Bengal Offset Works, 16/335, Khajur Road, (Joshi Rd.), Karolbagh, New Delhi-110005

ADVISORY COMMITTEE

Dr. Sitansu S. Jena
Chairman
NIOS, NOIDA (UP)

Dr. Kuldeep Agarwal
Director (Academic)
NIOS, NOIDA (UP)

Dr. Venkatesh Srinivasan
Assistant Representative
UNFPA, New Delhi

Ms. Gopa Biswas
Joint Director (Academic)
NIOS, NOIDA (UP)

Dr. Sonia Behl
Assistant Director (Academic)
NIOS, NOIDA (UP)

WRITING TEAM

Prof. R. D. Shukla
Professor & HEAD (Retd.)
DESM, NCERT
New Delhi

Dr. Vijay Sarda
Associate Professor
Zakir Husain Delhi College
Delhi University, Delhi

Sri R. S. Dass
Vice Principal (Retd.)
BRMVB Sr. Sec. School
Lajpat Nagar, New Delhi

Dr. M. K. Gandhi
Education Officer
CISCE Board
New Delhi

Dr. Ranjana Saxena
Associate Professor
Dayal Singh College
Delhi University, Delhi

Dr. D. K. Rao
Deputy Director
DEC, IGNOU
New Delhi

REVIEWING AND EDITING

Prof. R. D. Shukla
Professor & HEAD (Retd.)
DESM, NCERT
New Delhi

Dr. Vijay Sarda
Associate Professor
Zakir Husain Delhi College
Delhi University, Delhi

Sri Kanhaiya Lal
Principal (Retd.)
Dir. of Education
New Delhi

Sri R. S. Dass
Vice Principal (Retd.)
BRMVB Sr. Sec. School
Lajpat Nagar, New Delhi

Dr. M. K. Gandhi
Education Officer
CISCE Board
New Delhi

Dr. P. K. Mukherjee
Associate Professor
Deshbandhu College
Delhi University, Delhi

Dr. Bharti Sarkar
Reader (Retd.)
Maitreyi College
Delhi University, Delhi

Dr. Ranjana Saxena
Associate Professor
Dayal Singh College
Delhi University, Delhi

Mrs. Shivani Goswami
PGT & HOD (Retd.)
Mother International School
Aurovindo Marg, Delhi

Ms. Neelam Gupta
SEO
(EVS & Biology)
NIOS, NOIDA (U.P.)

Dr. Alok Kumar Gupta
Academic Officer
(Physics)
NIOS, NOIDA (U.P.)

Dr. Rajeev Prasad
Academic Officer
(Chemistry)
NIOS, NOIDA (U.P.)

LIFE SKILLS ADVISORY GROUP

Ms. Asheema Singh
Project Coordinator (AEP)
NIOS
NOIDA (U.P.)

Dr. Jaya
National Programme Officer (UNFPA)
55, Lodhi Estate
New Delhi

COURSE COORDINATORS

Ms. Neelam Gupta
SEO
(EVS & Biology)
NIOS, NOIDA (U.P.)

Dr. Alok Kumar Gupta
Academic Officer
(Physics)
NIOS, NOIDA (U.P.)

Dr. Rajeev Prasad
Academic Officer
(Chemistry)
NIOS, NOIDA (U.P.)

GRAPHIC ARTISTS

Mr. Mahesh Sharma
Graphic Artist
NIOS, NOIDA (U.P.)

Ms. Madhavi Rawat
Freelance Artist
New Delhi

Ms. Bakul Shroff
Freelance Artist
New Delhi

Developed under MHRD-UNFPA Supported: Adolescence Education Programme

A Word With You

Dear Learner,

Hope you must be enjoying studying the Science and Technology books through the self-learning material provided by NIOS. But as you might have understood by now, the true spirit of science lies in experiments. The experiments are not only at the root of growth and development of science but they are also essential for the learning of science. What you learn by doing activities and experiments indeed becomes a part and parcel of your personality. So, NIOS has kept laboratory work as an integral part of your Science and Technology curriculum which is provided to you in the form of a list of experiments at the end of that curriculum. You are expected to do most of these experiments but a minimum of 15 experiments are required to be done compulsorily. We know majority of you are resourceful enough to do most of the listed experiments on your own. However, some of you may require some guidance or help. So, keeping this in view, we have prepared this laboratory manual for you. Use it and complete your laboratory work with the help of your Study Centre and resource teacher. The laboratory manual is a part of NIOS self-learning material for Science and Technology curriculum, apart from the two volumes of theory, which also contain a lot of activities and experiments.

The major objectives of this laboratory manual are:

- *to familiarize you with some of the apparatus, tools and techniques used by scientists in their work.*
- *to develop in you a habit of taking minute observations, making plan for doing a work, working systematically and thinking logically.*

We are sure you will enjoy performing your experiments and mould yourself fully in the culture of science. In case you have any doubt or difficulty, feel free to consult your teacher or may even write to us.

Wishing you all success.

Ms. Neelam Gupta
SEO
(EVS & Biology)
NIOS, NOIDA (U.P.)
Email: neelam@nios.ac.in

Dr. Alok Kumar Gupta
Academic Officer
(Physics)
NIOS, NOIDA (U.P.)
Email: aophy@nios.ac.in

Dr. Rajeev Prasad
Academic Officer
(Chemistry)
NIOS, NOIDA (U.P.)
Email:aochem@nios.ac.in

INTRODUCTION

Science and Technology is a subject which can be learnt better by doing. The experiments inside or outside the laboratory give you an opportunity to understand the laws and principles of science. In fact, the experiments form an integral part of science learning. These help in developing scientific attitude and certain well-defined skills. While doing the experiments in a science laboratory, you will get a chance to handle scientific equipment and apparatus, chemicals etc. You will have to plan your work, make observations and draw conclusions. This process will help you in developing scientific attitude and habit of systematic work and logical thinking.

Let us first understand, what does an experiment mean? Is it just shaking test tubes or mixing some solutions or something more? An experiment has mainly five different components:

(i) Aim

(ii) Act or performance

(iii) Observations

(iv) Presentation of data

(v) Interpretation of data and drawing conclusion

With an aim in mind, we perform certain laboratory activities and make observations. On the basis of known scientific principles, we interpret the data and draw conclusions. For example, if you have to distinguish between ionic and covalent compounds, you perform a set of laboratory activities (tests), record observations, present it in a tabular form and finally draw the conclusions on the basis of observations.

The experiments designed for the Science and Technology course for the secondary stage of NIOS are presented in the form of self-instructional sheets in the following format-

- ***Aim:*** It defines the scope of the experiment.
- ***Objectives:*** The objectives of an experiment give you an idea about the skills or the knowledge that you are expected to develop after performing that experiment.
- ***What you should know:*** It highlights the importance of carrying out a particular experiment and gives you a brief description of the concepts related to the experiment which you are performing.
- ***Material required:*** It gives an exhaustive list of apparatus, chemicals, equipment and other material required to perform the experiment.
- ***How to perform the experiment:*** The steps are given in a sequential manner for setting up the apparatus and carrying out the experiment. The precautions, wherever necessary are incorporated in describing various steps.

- ***What to observe:*** A proper format of recording the observations is suggested in each experiment.
- ***Conclusions:*** It is an outcome from the observations and supports the aim set in the beginning.
- ***Check your understanding:*** At the end of each experiment, a few questions have been incorporated to consolidate what has been done and to check your understanding.

Before starting any experiment, you are advised to go through the detailed instructions given under it and plan your work accordingly. In case of any doubt, consult your teacher and get the clarification needed. Then start the experiment, proceed systematically according to the given instructions. Stop wherever you are in doubt and consult your teacher again to proceed further. It is necessary to follow the general safety measures while working in a science laboratory. This is essential for your own and safety and of others. A list of general safety measures is given below:

SAFETY IN A SCIENCE LABORATORY

Science laboratory is an exclusive work place for sincere workers. Go there with a sense of devotion and work honestly. A little carelessness can lead to accidents by which not only you may harm yourself but your neighbours too. Proper handling of apparatus, chemicals and other materials in the laboratory can prevent majority of accidents. Remember the following points while working in a science laboratory.

- Use all chemicals carefully.
- Replace the reagent bottles in their proper position after use.
- Do not mix chemicals unless required.
- Do not taste chemicals.
- Before using a chemical make sure it is the right chemical.
- Put off the gas to extinguish the flame of burner. Do not use any solid or liquid for this purpose.
- While pouring acids in the sink after use, do not forget to keep tap-water on so that they are completely flushed out.
- Do not keep volatile liquids such as alcohol, ether, acetone, etc. near the flame as these are highly inflammable.
- Do not throw broken glassware etc. in the sink. Such things should be thrown into the waste-paper basket.
- Do not talk to other students in the laboratory while performing the experiment. In case you have any difficulty, consult your teacher directly.
- Never point a test tube containing a reaction mixture or a mixture, which is being heated, towards your neighbour or yourself.
- Never pour water into concentrated acids. Rather add acid slowly to water in a container.
- Before leaving the laboratory wash your hands properly.

CUTS AND BURNS

- For wound caused by a broken glass or any sharp-edge object, remove the glass piece from the wound and control the bleeding by pressing on it a clean cloth or handcurchief or through a stern surgical dressing. Apply a little dettol spirit or burnol and cover it with a bandage.
- For wounds due to acid burns, wash well with water and then with a 2% solution of sodium bicarbonate. Then apply bumol on the wound.
- For wounds due to heat of the flame, put the burnt portion under cold water. Then apply burnol.

RECORD BOOK

Now, you may be interested in knowing how to maintain the record book for the experiments. While performing the experiment you would have undergone several steps as given in this manual. But for writing the experiment in the record book, you need not write the details of the procedure of performing the experiment. It should be in the format having the following five sections only:

- ***Aim*** of the experiment.
- ***Material required*** for the experiment.
- ***Observations*** which you take during the experiment.
- ***Conclusion*** which is drawn on the basis of the observations.
- ***Precautions*** taken by you while performing the experiment.

The list of experiments is given in the content part of this manual, which is divided into three sections. You are required to ***perform at least fifteen experiments in all,*** *of* which ***at least three should be from each section.***

In case you have any problem or doubt consult your science teacher or write to us without any hesitation. We hope that will be able to perform all the experiments successfully.

MARKING SCHEME FOR PRACTICAL EXAMINATION

Time: 2½ Hrs.		**Max. Marks: 15**
1.	Two Experiments (2 × 4 = 8) (Both the experiments should not be from the same section)	8
2.	Record Book	4
3.	Viva-voce	3
	Total	15

CONTENTS

Biology

EXPERIMENT 1

To Determine the Density of the Material of a Given Solid Using a Spring Balance and a Measuring Cylinder

OBJECTIVES

After performing this experiment you should be able to:

- *use a spring balance to measure the weight of a body;*
- *measure the volume of a given quantity of a liquid using a measuring cylinder;*
- *show that on immersing in a liquid, a solid displaces liquid equal to its own volume;*
- *explain why some solids float on water where as some others sink; and*
- *determine the density of the material of a solid by measuring its mass and volume.*

1.1 WHAT YOU SHOULD KNOW

(i) Quite often we compare materials on their heaviness, e.g., we say that iron is heavier than wood. What do we mean by this statement? We mean that the mass of 1 c c of iron will be more than the mass of 1 cc of wood. The mass of a unit volume of a substance is called its density. The density is thus a measure of its heaviness; More the density, heavier is the substance. If you have one block of iron and the other of wood of the same size (volume) the former is heavier than the latter.

The density of a substance is mathematically given by

$$\text{Density} = \frac{\text{Mass of the body}}{\text{Volume of that body}}$$

SI Unit of density is kg m^{-3}. We also measure density in g/cm^3.

(ii) We use spring balance for measuring weight, because, elongation in a suspended spring is directly proportional to the load attached to its free end. Also the numerical value of the weight of a body measured in gravitational unit (gram weight) is equal to its mass (gram). Thus we can calibrate a spring balance to directly measure mass in gram.

(iii) Solids and liquids have definite volumes. Solids are rigid and have definite shapes. Liquids on the other hand acquire the shape of the containers. Different solids and liquids differ in their densities. A solid which is denser than a liquid will sink in it and if it is lighter than the liquid, it will float on it. If a solid sinks in a liquid, it displaces the liquid equal to its own volume. This fact you will use while measuring the volume of the given solid using a measuring cylinder.

Material Required

The given solid of suitable size (a potato or a piece of stone/iron/aluminium or glass/plastic, paper weight, etc.), a spring balance of suitable range (depending on the size of the solid given), A measuring cylinder of suitable range, a thread, an iron stand (or a nail on the wall), a suitable liquid (water) in a beaker.

1.2 HOW TO PERFORM THE EXPERIMENT

[A] To find the mass of the given Body (Solid)

1. Place the iron stand on a rigid, horizontal surface (table top) and hang the spring balance on it vertically. (You can also hang the balance on a long nail put on the wall). (Fig. 1.1)
   (i) Generally the pointer of the spring balance coincides with the zero mark of its scale. In case it is not so, adjust the pointer to zero position with the help of the adjusting screw at the top of it. If there is no adjusting screw, note the position of the pointer on the scale.
   (ii) Find the least count of the spring balance (i.e. the value of mass between two successive marks)
   (iii) Tie a thread to the body and make a loop at the free end of the thread. Suspend the solid from the hook of the spring balance.
   (iv) Note the new position of the pointer. Substract the original reading of the spring balance (in step (i)) from this. It will give you the mass of the solid.

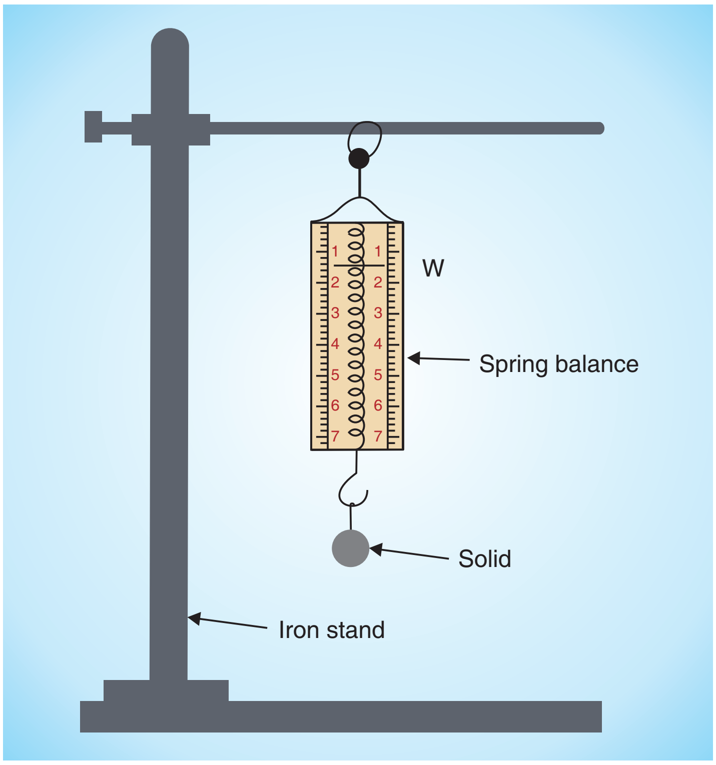


Fig. 1.1: *Determination of mass of solid using spring balance*

[B] To find the volume of the body

(i) Place the measuring cylinder on a rigid horizontal surface (table top, say)

(ii) Find its least count (i. e. the minimum volume it can measure) by finding the value of volume between two successive marks on it.

(iii) Take a non toxic, non-volatile liquid (e.g. water) at room temperature in which solid sinks and which has no chemical reaction with its material (Note: if the given solid has these properties then water is a suitable liquid)

(iv) Gently pour the liquid in the measuring cylinder, along its walls and fill nearly half of it with the liquid.

(v) Note the initial level of the liquid in the measuring cylinder, keeping your eye on the same level as the lower meniscus of the liquid. (Fig. 1.2). Let it be V_1.

(vi) Gently, lower the solid in the cylinder with the help of a thread and read the level of water again (Fig. 1.3). Let it be V_2.

(vii) The difference between the observations taken in step (v) and (vi) above gives us the volume of the given solid.

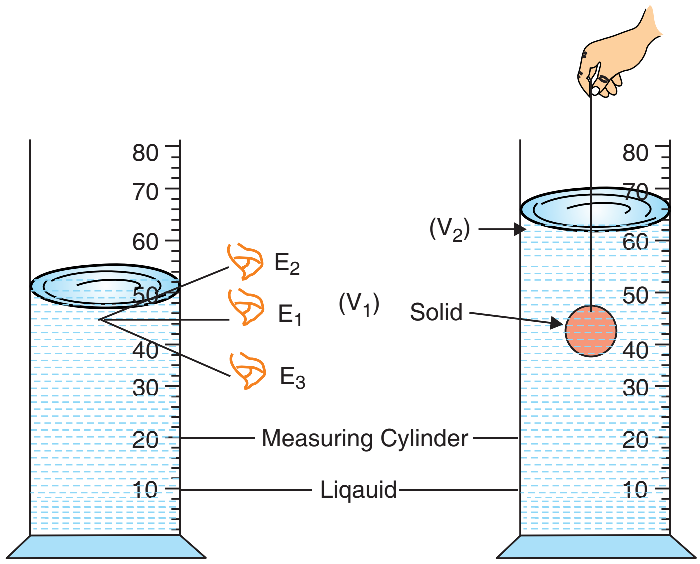


Fig. 1.2: Reading level of liquid in *a measuring cylinder*

Fig. 1.3: Level of liquid in a cylinder *after lowering solid in it*

[C] Density of The Material of The Given Solid

Substituting the values of mass obtained from step (iv) in (A) and volume obtained from step (vii) in (B), in the following formula, calculate the density of the material of the given solid.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

1.3 WHAT TO OBSERVE

[A] Measurement of Mass

(i) Least count of the spring balance = ... g

(ii) Initial reading of the pointer of spring balance (m_1) = ... g

(iii) Final reading of the pointer of the spring balance (m_2) = ... g

(iv) Mass of the given solid, (m) = ($m_2 - m_1$)g = ... g

[B] Measurement of Volume of the solid

(i) Least count of the measuring cylinder = ... cm^3 (mL)

(ii) Initial level of the liquid in the measuring cylinder = (V_1) = ... cm^3 (mL)

(iii) Final level of the liquid in the measuring cylinder after lowering the solid in it, (V_2) = ... cm^3 (mL)

(iv) Volume of the solid, (V) = ($V_2 - V_1$) cm^3 = ... cm^3

[C] Calculation of Density of the material of the solid

$$d = \frac{m}{V} = \text{.................} \ \mathrm{g\ cm^{-3}}$$

1.4 CONCLUSIONS

(i) Mass of the given solid = ... g

(ii) Volume ofthe given solid = ... cm^3

(iii) Density of the material of the given solid = ... g cm^{-3}

Improvising a Measuring Cylinder

In case you do not has an easy access to a measuring cylinder, you may improvise one as follows:

You may have in your home (or obtain it from a crockery shop for use in your home) a glass tumbler or bottle (like a jam bottle) having cylindrical shape i.e. the one having the same diameter at its top and bottom. Measure its internal diameter with a scale. Paste a vertical strip of graph paper on it (Fig. 1.4) to make it a measuring cylinder. The strip has millimeter marks on it. Calculate the volume of 1 mm height of liquid filled in the tumbler. This is the least count of your measuring cylinder. For example, if the internal diameter of the tumbler is 6.0 cm, then the volume of 1 mm height of liquid in it is:

$$\pi r^2 h = \frac{22}{7} \times 3.0 \times 3.0 \times \frac{1}{10} = 2.8 \ \text{mL}$$

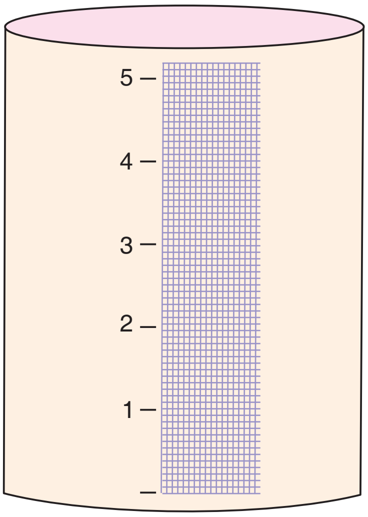


Fig. 1.4: *Improvising a measuring cylinder*

1.5 CHECK YOUR UNDERSTANDING

(i) (a) Which is heavier 1 kg cotton or 1 kg iron?

....

(b) Which is denser lkg cotton or 1 kg iron? Explain.

....

(ii) Which would you prefer for measuring the volume of 4.6 mL, of milk, a measuring cylinder of capacity 50 mL and least count 1 mL or a measuring cylinder of capacity 500 mL and least count 5 mL? Why?

....

(iii) How many cc (cubic centimeters) make one litre?

....

(iv) How will you modify the experiment to measure the density of wood?

....

(v) Density of brass is more than the density of aluminium. If pieces of brass and aluminium having equal masses be taken, which one will displace more water? Explain.

....

Science can purify religion from error and superstition. Religion can purify science from idolatry and false absolutes.

– John Paul II, Pope (Karol Wojtyla)

EXPERIMENT 2

To Find the Average Speed of an Individual, as One Walks/Runs, To and Fro between Two Points

OBJECTIVES

After performing this experiment, you should be able to:

- *measure the distance travelled by a moving body;*
- use a stop watch to measure the time interval of an event; and
- *measure average speed of a moving body during a given time interval.*

2.1 WHAT YOU SHOULD KNOW

Speed is the physical quantity, which tells us how fast has a body moved between two positions. Normally in moving long distances a body does not move equally fast all the time. The average speed of a body over a given time interval is given by:

$$\text{Average speed} = \frac{\text{Total distance moved by the body (path length)}}{\text{Total time taken}}$$

Material required

A metre scale and a stop watch

2.2 HOW TO PERFORM THE EXPERIMENT

1. Mark two fixed points A and B on the ground 20 metres or more apart.
2. Let your friend stand at one point (say A), instructed him/her to start walking/running when you speak "Start" and then make 5 to 10 walks from A to B, then B to A, and so on.
3. Say "Start" and simultaneously start the stop watch (OR, note the time with the help of seconds - hand in your watch, in case a stop watch is not available). Simultaneously, your friend starts walking (Fig. 2.1).
4. Keep on counting the number of times your friend has moved between the two points.
5. When he completes his last trip (AB or BA), say "STOP" and stop the watch at the instant he reaches the marked point.

Fig. 2.1: *A person running on a straight path between points A and B.*

6. Measure the length. AB with the help of a metre scale.
7. If your friend has covered length AB, n times, total distance moved by him *is* ($n \times AB$).
8. Note the time by your stop watch and calculate average speed.
9. Repeat the experiment atleast three times. Are the three results equal? Find their mean.
10. Repeat the experiment, when your friend runs between the same two points.

(**Note:** You yourself can walk/run between the points A and B with the stop watch in your hand and perform the experiment.)

2.3 WHAT TO OBSERVE

(A) Speed of a Person when the Person Walks

Distance between marked points AB = d = ... m

S.No.	No. of times the person moves the distance AB = (n)	Total distance travelled = n d (metre)	Time taken t (second)	Average speed = nd/t (ms^{-1})
1.				
2.				
3.				

Mean value of the average speed of walking = ... ms^{-1}

(B) Speed of the person when the person runs

S.No.	No. of times the person moves the distance AB = n	Total distance travelled = n d (metre)	Time taken t (second)	Average speed = nd/t (ms^{-1})
1.				
2.				
3.				

Mean value of the-average speed of running = ... ms^{-1}

2.4 CONCLUSIONS

1. The person walked lengths AB (of .... m) with an average speed of .... ms^{-1}.
2. The person ran lengths AB (of .... m) with an average speed of .... ms^{-1}.

2.5 CHECK YOUR UNDERSTANDING

1. While moving to and fro between A and B, is your friend moving equally fast when he is in the middle and when he is close to A or B? If no, where is he fastest?

   ....

2. A person moves from A to B (a distance of 50 m) and returns back to A in 1 minute 40 second. What is the average speed of the person?

   ....

3. The distance meter of a truck shows that it has travelled a distance of 60 km in one hour. Will its speed-metre read 60 km h^{-1} for the whole journey?

   ....

4. Convert 18 km h^{-1} into ms^{-1}.

   ....

5. How will you measure the average speed of walking if you do not have a stop watch or your watch with a seconds-hand, but have a device which gives a signal after every 5 second?

   ....

EXPERIMENT 3

To Observe and Compare the Pressure Exerted by a Solid Iron Cuboid Placed on Fine Sand/Wheat Flour while Resting on its three different Faces and Calculate the Pressure Exerted in the three different Cases

OBJECTIVES

After performing the experiment, you should be able to:

- *select a spring balance of suitable range and least count in accordance with the weight of the body;*
- *measure weight of a body using a spring balance;*
- *demonstrate that pressure applied is more if the force is applied on a smaller area; and*
- *Calculate the pressure exerted by a body on the surface of contact.*

3.1 WHAT YOU SHOULD KNOW

- Thrust is defined as the force acting normally on a surface.
- Pressure is defined as thrust per unit area i.e. $\text{Pressue} = \dfrac{\text{Thrust}}{\text{Area}}$.
- When a body is placed on a surface, its weight exerts thrust on the surface.
- The weight of a body of mass m is given by W = mg newton, where g is acceleration due to gravity at the place.
- A cuboid has six faces with three pairs of opposite faces having different surface area.

Material Required

A tray having fine wheat flour (or sand). A metallic cuboid (approximate mass 1 kg), a spring balance, a thread and a half metre scale.

3.2 HOW TO PERFORM THE EXPERIMENT

1. Place the tray of wheat flour on the table and level the top surface of the flour. Do not press it to decrease volume (Fig. 3.1).

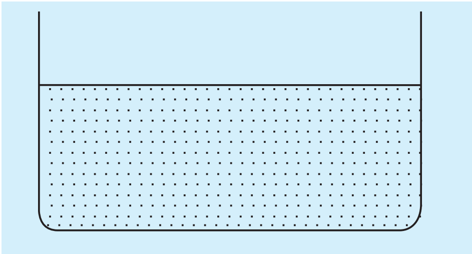


Fig. 3.1: *Tray having wheat flour*

2. Select a suitable spring balance which has range more than the weight of the cuboid. Hang the spring balance vertically on a nail put in the wall.
3. Tie a thread in the middle of the metallic cuboid and make a loop in the thread and hang it on the spring balance and measure its weight (Fig. 3.2).
4. With the help of metre scale measure the length l, breadth b and height h of the cuboid. For this place the cuboid along the scale and measure the length keeping your eye normal to the mark at each side (Fig. 3.3). The distance between the positions of point P and Q gives us the length of the cuboid. Similarly breadth and height may also be determined.

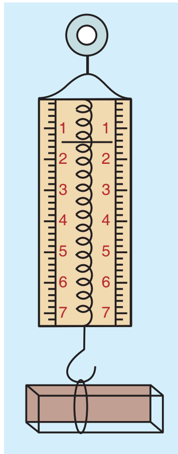
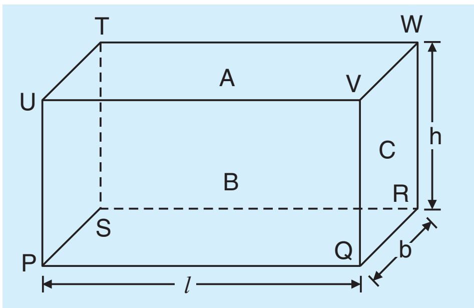


Fig. 3.2: *The cuboid suspended on the hook of spring balance to measure its weight*



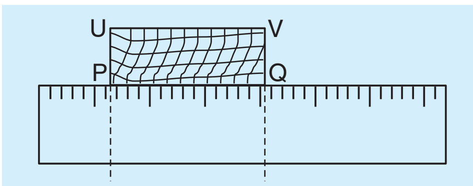


Fig. 3.3: *Positioning the cuboid along the scale*

5. Now, gently place the cuboid with face PQRS (or UVWT) on the wheat flour and see how much height of it gets submerged in the flour.
6. Repeat step 5 with face PQVU and then with face QRWV on the flour.

3.3 WHAT TO OBSERVE

A. Determination of weight of the cuboid

1. Range of the spring balance = 0 .... gwt = (0 N ....)
2. Least count of spring balance = ... gwt = ... N
3. Weight of the cuboid, mg = ... gwt = ... N

B. Measurement of length, breadth and height of the cuboid

1. Length of the cuboid = ... cm = ... $\times 10^{-2}$ m
2. Breadth of the cuboid = ... cm = ... $\times 10^{-2}$ m
3. Height of the cuboid = ... cm = ... $\times 10^{-2}$ m

C. Depth of the cuboid immersed in the flour

1. Depth is maximum when the face .... is placed in the flour
2. Depth is minimum when the face .... is placed on the flour.

3.4 CALCULATIONS

1. Area of face PQRS, $A_1 = l \times b$ = ... cm × .... cm = ... cm^2 = ... m^2
2. Area of face QRWV, $A_2 = b \times h$ = ... cm × .... cm = ... cm^2 = ... m^2
3. Area of face PQVU, $A_3 = l \times h$ = ... cm × .... cm = ... cm^2 = ... m^2
4. Pressure on flour when cuboid is placed on face PQRS = $\frac{mg}{A_1}$ = ... Nm^{-2}
5. Pressure on flour when cuboid is placed on face QRWV = $\frac{mg}{A_2}$ = ... Nm^{-2}
6. Pressure on flour when cuboid is placed on face PQVU = $\frac{mg}{A_3}$ = ... Nm^{-2}

3.5 CONCLUSIONS

1. Area of face PQRS, i.e. A_1 is maximum and hence the pressure on flour when the cuboid is placed on this face is minimum, that is why it immerses the least in the flour. You will find that this is in conformity with the observation.
2. Area of face QRWU i.e., A_2 is least and hence pressure on flour with this position of cuboid is maximum and it immerses through maximum depth in the flour. You will find that this is in conformity with the observation.

3.6 CHECK YOUR UNDERSTANDING

1. The mass of a cuboid is 100 g, what is its weight in newtons?

   Ans. 1 N

2. Express the area of a rectangle of length 10 cm and breadth 5 cm in m^2.

   Ans. 5×10^{-3} m^2.

3. What is the mass of 1 L of water?

   Ans. 1 kg.

4. The area of base of a beaker of capacity 500 mL is 100 cm^2. What is the pressure of water contained in it at its base if the water is filled in it upto the brim?

   Ans. $P = \dfrac{0.5 \times 10}{100 \times 10^{-4}} = 500 \text{ Nm}^{-2}$

5. What is the other name for the unit Nm^{-2}?

   Ans. Pascal (Pa)

6. Will it make any difference if we use wet sand in place of dry sand? Why?

   Ans. In wet sand the block will penetrate lesser depth as compared to the depth it will immerse into dry sand. However, marking the depth for comparison would become easier, because, the sand particles come closer together and separation between them becomes almost fixed.

EXPERIMENT 4

To Verify the Third Law of Motion Using Two Spring Balances

OBJECTIVES

After performing the experiment, you should be able to:

- d*emonstrate that the extension in the spring of a spring balance is directly proportional to the force applied on it;*
- *entangle two spring balances in such a way that force applied on one may act on the other; and*
- *verify third law of motion.*

4.1 WHAT YOU SHOULD KNOW

- A spring balance is used for measuring force.
- The principle of working of a spring balance is "stretch in a uniformly wound spring is directly proportional to the stretching force".
- Even if the spring balance is calibrated in the unit of mass (g or kg), the readings may be converted into the unit of force (i.e. N) by multiplying mass with acceleration due to gravity at the place.
- Force is a result of interaction between two bodies, the force that one body applies on the other body is called action and the force that the second body applies on the first body is called reaction.
- According to Newtons third law of motion, "action and reaction are equal in magnitude, opposite in direction and act on two different bodies."

Material Required

Two identical spring balances (0-5 N), weight box, a frictionless pulley, a hanger of 1 N (= 100 gwt) and 3-4 slotted weights each of 1 N to be placed on the hanger, an inextensible, torsionless, massless string and a heavy wooden block with a hook.

4.2 HOW TO PERFORM THE EXPERIMENT

1. Take two identical spring balances each of range 0-5 N.
2. Find the least count of the two spring balances.

3. Hold the two spring balances vertically and see whether their pointers are at zero mark or not. Adjust the pointers at zero mark if need be.
4. Fix the wooden block at one edge of the table and pulley at its opposite edge keeping the two in a straight line. Attach balance B with the block, entangle the hooks of spring balances A and B and tieing thread with A pass it over the pulley and attach hanger weight to its free end as shown in Fig. 4.1. In this arrangement the spring balances rest on the table top, the thread remains parallel to it and the thread and weight on the other side of the pulley hang freely and do not touch the table.

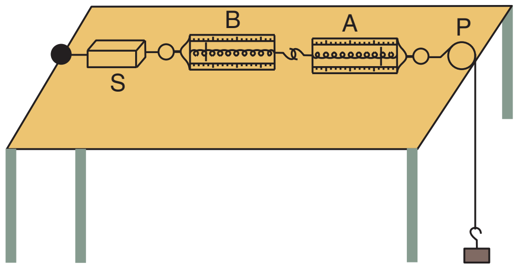


Fig. 4.1: *Experimental set-up*

5. Note readings in the two spring balances.
6. Add at least 3 more weights in steps of 1 N on the hanger and note readings in the two spring balances each time.

4.3 WHAT TO OBSERVE

1. Range of spring balance A = Range of spring balance B = 0 to ...... g wt = 0 to ...... N
2. Least count of spring balance A = Least count of spring balance B ...... g wt .... N
3. Acceleration due to gravity at your place, g = ... ms^{-2}
4. Weight of the hanger w = ... g wt = ... N.
5. Table for action and reaction

S.No.	Additonal weight on the hanger W (N)	Total force applied to the balance $W + W$ (N)	Reading in spring balance (A) F_A (N)	Reading in spring balance (B) F_B (N)	$F_A - F_B$
1.	0	1 N			
2.	1	2 N			
3.	2	3 N			
4	3	4 N			
5	4	5 N			

4.4 CONCLUSIONS

1. $F_A - F_B = 0 \Rightarrow F_A = F_B$, i.e., action of balance A on B is equal to reaction of balance B on A. Thus action and reaction are equal and opposite and act on two different bodies. The third law of motion stands verified.
2. If $F_A - F_B \neq 0$, there is error in the experiment and the sources of errors are to be discussed.

4.5 CHECK YOUR UNDERSTANDING

1. When a load of 1 N is applied on a spring it gets stretched by 1 cm, how much load will pull its to stretch by 3 cm.

   Ans. 3 N
2. Will a coupled system move due to mutual force of action and reaction?

   Ans. No.
3. How to explain this?

   Ans. Because, forces of action and reaction are equal and opposite, they will cancel each other.
4. In a tug of war what are the action and reaction forces?

   Ans. Action of one team on the rope – action, tension in the rope – reaction.
5. What happens when the rope is snapped?

   Ans. The two teams fall backward in opposite direction.
6. How to explain this?

   Ans. Because, each team is applying force on the rope in opposite direction. When the rope snaps tension in the rope goes and the teams fall backwards because of the imbalanced forces acting on them.

EXPERIMENT 5

To Determine the Melting Point of Ice

OBJECTIVES

After performing the experiment, you should be able to:

- u*se a laboratory thermometer;*
- *set up apparatus to determine melting point of ice; and*
- *show that melting point is a characteristic constant temperatures for a given solid.*

5.1 WHAT YOU SHOULD KNOW

- A solid changes into its corresponding liquid state at a fixed, characteristic temperature, called its melting point.
- Melting point and freezing point for a given substance have same value.
- When a solid starts melting at its melting point its temperature remains constant till whole of the solid is converted into liquid state.

Material Required

A big funnel (15 cm dia at top), a thermometer, a beaker, an iron stand with funnel holder and clamp.

5.2 HOW TO PERFORM THE EXPERIMENT

1. Arrange the funnel, beaker and thermometer on the iron stand as shown in Fig. 5.1. See that the funnel and the thermometer are securely clamped in the iron stand making thermometer vertical.
2. Fill the funnel with broken pieces of ice burying the bulb of the thermometer in the ice from all sides.
3. Keep on noting the reading of the thermometer after every thirty seconds.
4. Note the temperature which becomes constant and does not change with time. This is melting point of ice.

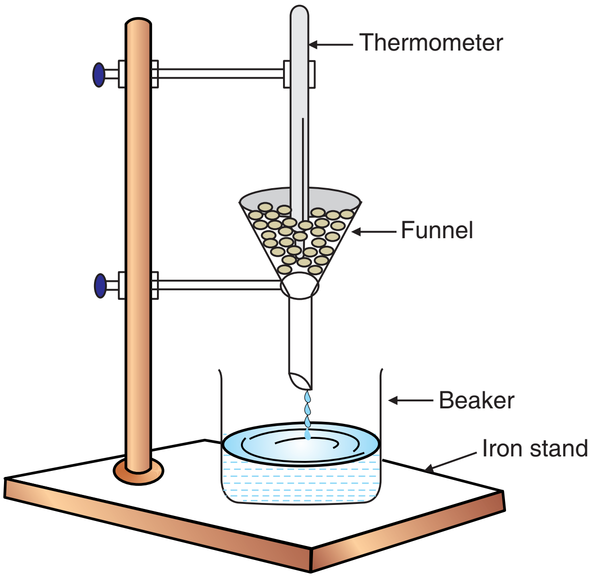


Fig. 5.1: *Experimental set up for finding melting point of ice*

5.3 WHAT TO OBSERVE

S.No.	Time (min)	Temperature (°C)
1.	½	
2	1	
3	1½	
4	2	
5	2½	
.	.	
.	.	
.	.	

5.4 CONCLUSION

Melting point of ice = ... °C

5.5 CHECK YOUR UNDERSTANDING

1. Melting point of ice as mentioned in tables of constants is 0°C. Your value is not 0°C. What may be the reason?

   Ans. 0°C is the melting points of pure ice at atmosphere. If atmospheric pressure is changed or ice is not made of pure water then its melting point may not be 0°C.

2. How does the melting point of ice change on adding impurities.

   Ans. Melting point of ice decreases with addition of impurities

3. How does the melting point of ice change with increase in pressure?

   Ans. Melting point of ice decreases with increase in pressure.

EXPERIMENT 6

To Study the Laws of Reflection of Light Using a Plane Mirror

OBJECTIVES

After performing this experiment, you should be able to:

- *draw the reflected rays on a plane mirror strip for given incident rays;*
- *Measure the angle of incidence and the angle of reflection; and*
- *Varify the laws of reflection of light.*

6.1 WHAT YOU SHOULD KNOW

As you know the light incident on a smooth surface is reflected back into the same medium in accordance with two laws. These are known as laws of reflection, and are given below:

1st law of reflection : The incident ray, the reflected ray and the normal to the reflecting surface at the point of incidence, lie in the same plane.

2nd law of reflection : The angle of incidence is equal to the angle of reflection i.e. $\angle i = \angle r$.

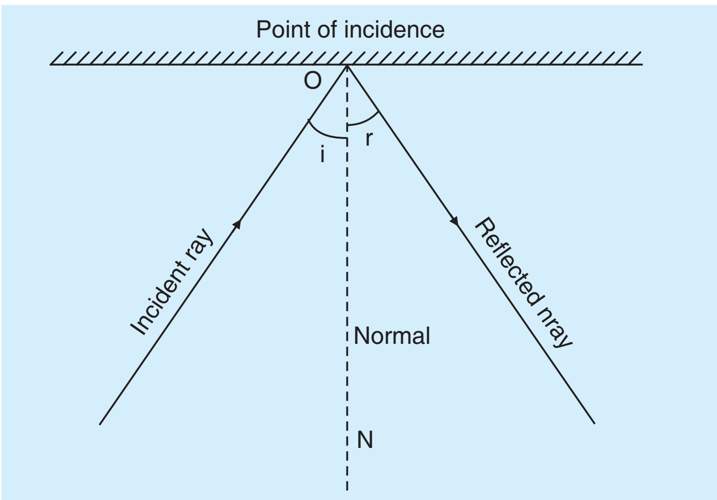


Fig. 6.1: *Reflection of light*

Material Required

A plane mirror strip about 2.5 cm wide and 10 cm long with wooden support to hold it vertical. 4 pins, drawing board, a sheet of paper, pencil, eraser and 30 cm scale, 4 drawing pins to fix the sheet of paper on the drawing board, a small weight to fix the pins on the sheet of the board; a protractor.

6.2 HOW TO PERFORM THE EXPERIMENT

(i) Place the drawing board on a table. Spread the drawing paper on the drawing-board and pin it up at the four corners with four drawing-pins.

(ii) Draw a line M_1, M_2 on the drawing paper. Now fix the plane mirror strip in wooden stands to hold it vertically. Stand the mirror strip on the drawing paper with its reflecting surface (rear surface) coinciding with M_1, M_2 as shown in Fig. 6.2.

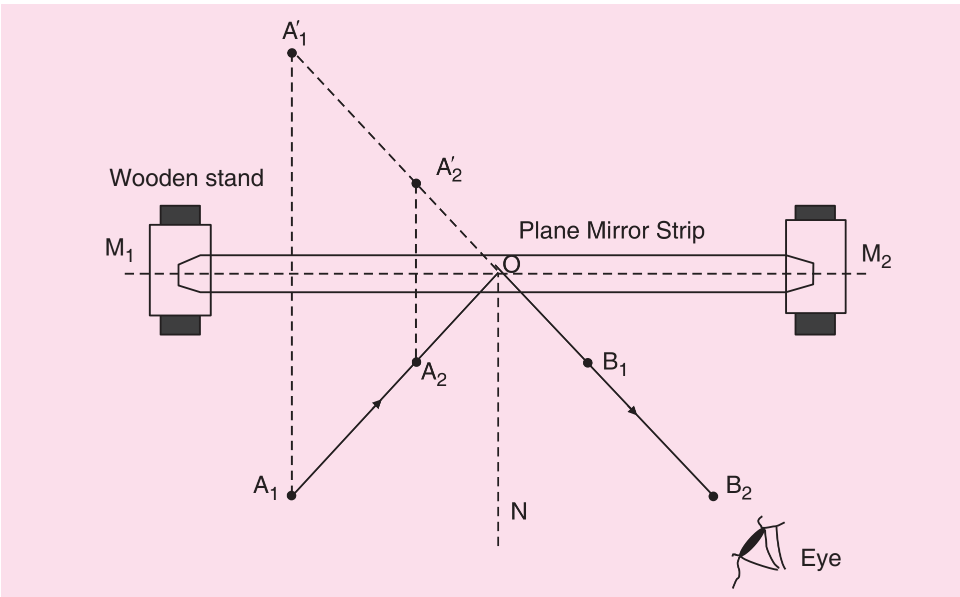


Fig. 6.2 : *Plane mirror strip fixed vertically in a wooden stand*

(iii) Draw an oblique line A_1, A_2 on the drawing paper.

(iv) Fix two pins A_1 and A_2 vertically on this oblique line at least 6 cm apart, as shown in Fig. 6.2. ***The pins should stand vertical on the horizontal drawing board.***

(v) Now bring your eyes in horizontal plane slightly above the drawing paper on the other side of the normal ON and to look at the images of the pins into the mirror strip. Look slightly obliquely at the opposite inclination to the normal of the plane mirror.

(vi) Adjust your eye to see the images A'_1 and A'_2 of the pins A_1 and A_2 in a line.

(vii) Now fix the third pin B_1 in line with the images A'_1, and A'_2 so that it covers the images of both the pins.

(viii) Take another pin and fix it in position B_2 in line with the pin B_1 and images A'_1 and A'_2. **Take care that the lower ends (bottom) of the newly fixed pins B_1 and B_2 are exactly in line with the lower ends of the images A¢$_1$ and A¢$_2$ of the pins A_1 and A_2 in the mirror strip**

(ix) Now remove all the pins A_1, A_2, B_1 and B_2 which leave behind the pin hole marks on the drawing paper.

(x) Draw a straight line B_1B_2 using pencil and scale passing through the marks of pins B_1 and B_2 on the drawing paper and extend it to the base line M_1M_2 of the mirror strip M.

(xi) Also extend the line, A_1 A_2 to meet the line B_1 B_2 at O. O is the point of incidence. If point O is not on the base line M_1 M_2 draw a line. M_1 M_2 parallel to M_1 M_2 passing through O.

(xi) Now A_2 A_1O is the incident ray and O B_1B_2 is the reflected ray.

(xiii) Draw a line ON at right angles to line M_1M_2 at the point O. This line ON is therefore, the normal at the point of incidence O of the mirror.

(xiv) Measure the angle of incidence and the angle of reflection with the help of protractor. (Provided in your geometry box.)

(xv) Repeat the experiment for at least three different values of angle of incidence.

(xvi) Record the values of the angle of incidence and the corresponding angle of reflection in the following table.

6.3 WHAT TO OBSERVE

(i) Because mirror stands perpendicular to plane of paper, normal to mirror lies in the plane of paper. It is the line ON on the drawing-paper. Also incident ray A_2, A_1O and reflected ray OB_1B_2 are in the plane of paper. Hence, all the three i.e., incident ray, reflected ray and normal at the point of incidence lie in the same plane.

(ii) **Table 6.1:**

S.No	Angle of incidence ($\angle i$)	Angle of reflection ($\angle r$)	Difference between $\angle i$ and $\angle r$ i.e. ($\angle r - \angle i$)
1.			
2.			
3.			

6.4 CONCLUSION

(i) Observation (i) verifies the first law of reflection.

(ii) As seen from the Table 6.1 the angle of incidence is found to be equal to the angle of reflection within the limits of experimental error, therefore, the second law of reflection is verified.

6.6 CHECK YOUR UNDERSTANDING

(i) What is the angle of incidence when the direction of incident ray A_1A_2O coincides with that of the normal NO in Fig. 6.2.

(ii) What should be the angle of reflection when the incident ray falls normally on the surface of the mirror strip?

(iii) If you join A_1 with A'_1 by a straight line, then in what ratio the line M_1M_2 divides the line A'_1A_1?

(iv) If the incident ray makes an angle of 30° with the plane of mirror, i.e. with M_1M_2, then what will be the angle of reflection?

(v) If a pin is fixed at a distance of 4 cm in front of a plane mirror where and at what distance will the image be formed?

(vi) You are advised to take a thin mirror strip to verify the laws of reflection. why?

> *"The scientific method," Thomas Henry Huxley once wrote, "is nothing but the normal working of the human mind." That is to say, when the mind is working; that is to say further, when it is engaged in correcting its mistakes.*
>
> *– Postman, Neil*

EXPERIMENT 7

To Study the Change in the Size, and Position of Image formed by a Convex Lens by Changing the Position of an Object (Candle) Placed in front of it

OBJECTIVES

After performing this experiment, you should be able to:

- *adjust the positions of the object (candle) and the convex lens along a metre scale;*
- *focus the image properly;*
- *observe the dependence of the size, nature and position of image on the position of the object; and*
- *estimate the focal length of the convex lens.*

7.1 WHAT YOU SHOULD KNOW

A convex lens has the property of converging a parallel beam of light to a point. This point is called its focus. Distance of this point from the lens is its focal length. Due to this property, the lens can form an image of any luminous object on a screen placed at the right distance from the lens. Size of image and its distance from the lens depends on the location of the object.

Material Required

A candle with stand, a convex lens (diameter 5 cm, f = 15 cm), a ground glass screen/ white card board piece mounted in a frame with a handle, three uprights to mount the candle the lens and the screen, lens holder, a meter scale, a match box and adhesive tape.

7.2 HOW TO SETUP THE EXPERIMENT

The stands for lens and ground glass screen must be so designed that the height of the centres of convex lens, ground glass and candle flame above the table top be equal. In case of candle, length of candle may be reduced by cutting it by a blade from below.

Fix the metre scale on table by adhesive tape. The three stands can slide along it. Put the candle near one end of the scale, lens in the middle and screen behind the lens (Fig. 7.1)

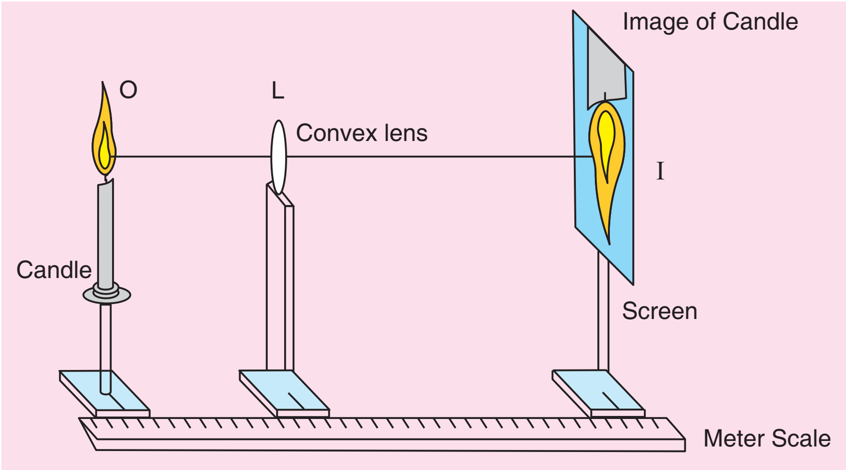


Fig. 7.1: *Setting of the experiment for convex lens.*

For the lens to make a real image of the candle at the centre of the screen, the centres of O, L and I must lie in a straight line, i.e, they should be at equal heights above the table as also at the same horizontal distance from the scale.

7.3 HOW TO PERFORM THE EXPERIMENT

(i) Find rough focal length of the lens by focussing the image of the Sun or of any other distant object out side the window of the laboratory on your screen. The distance between the image and the lens is the roughly estimated focal length of the lens. Measure it with a metre scare.

(ii) Put the lens, L, at a distance slightly greater than its focal length from the candle O.

(iii) Move the screen forwards/backwards along the scale so that a sharp image of the candle flame is formed on the screen. To identify position of sharpest image observe the vertical boundary of the flame, which is a fairly sharp boundary.

(iv) By the marks already existing on the three stands, read the positions of O, L, and I on the metre scale, and record them.

(v) Observe and record whether the image is real/virtual, inverted/erect and smaller/larger than object.

(vi) Compute the object distance OL and the image distance LI.

(vii) Repeat the steps (ii) to (vi) three more times by moving the object (i.e. the candle) a little away from the lens thereby increasing the object distance gradually and get a sharp image of the candle on the screen in each case.

(viii) Place the candle at a distance less than the rough focal length of the lens and note the size and nature of the image formed. Try to form the image on the screen.

7.4 WHAT TO OBSERVE

Rough focal length of the convex lens = ... cm.

A. Table: Measurement of distance of the object and the image

S.No.	Position of			Object distance	Image distance	Size of the image (Magnified/ diminished/ same size)	Nature of the image (real/ virtual, Erect/ inverted)
	O (cm)	L (cm)	I (cm)	OL (cm)	LI (cm)		
1.							
2.							
3.							
4.							

B. When the candle is placed between focus and optical centre the image seen is enlarged but it can not be taken on screen

7.5 CONCLUSIONS

(i) For any object distance more than *f*, the image is ...., ...

(ii) As object distance decreases, but is more than the *f* of the lens, the image distance goes on .... and the size of real image goes on ....

(iii) When image distance is greater than the object distance, image is .... and when image distance is less than the object distance, image is ....

(iv) When the object distance is less than the rough focal length of the lens, the image is .... (virtual/real, erect/inverted, magnified/diminished)

7.6 CHECK YOUR UNDERSTANDING

(i) At what position of the object with respect to the focal length of the lens, the image size seems to be equal to the object size?

....

(ii) Can you do a similar experiment with a concave lens? Give one reason.

....

(iii) Will the size of the image depend upon the size (or diameter) of the convex lens if the object distance is same in each case?

....

EXPERIMENT 8

To Study the Change in Current through a Resistor by Changing Potential Difference across it. Determine the Resistance of the Resistor by Plotting a Graph between Potential Difference and Current

OBJECTIVES

After performing this experiment, you should be able to:

- *determine the least count of an ammeter and a voltmeter;*
- *make connections in accordance with given circuit diagram;*
- *recognize the sources of error in the electric circuits;*
- *draw a graph between V and I;*
- *interpret the graph and compute the electric resistance of the given resistor and*
- *recognise a relation that the potential of the cells connected in series is the sum of the potential difference of individual cells.*

8.1 WHAT YOU SHOULD KNOW

Electricity has become an integral part of our life. In your day to day life you might have seen different sources of electricity and different type of electrical circuits. Every electrical circuit possesses some resistance which depends upon the nature of material, length, and area of cross-section of the resistor and its physical conditions like temperature and pressure.

You know that according to Ohm's law, if the potential difference across a resistor increases, the electric current passing through it also increases in the same proportion. It can be concluded that the ratio of potential difference across a conductor and the electric current through it remains constant provided the temperature remains constant i.e.

$$\frac{V}{I} = \text{R (a constant)}$$

Where R is known as the resistance of the resistor.

Now, if potential difference across the ends of a resistor of resistance R changes, the corresponding electric current through it also changes and the ratio of potential difference and current remains constant.

Material Required

Four fresh cells each of emf 1.5 V, a wire of certain length and area of cross-section (resistor), an ammeter, a voltmeter, connecting wire, a new key and a piece of sand paper.

8.2 HOW TO PERFORM THE EXPERIMENT

(i) Note the range of the given ammeter and the voltmeter.

(ii) Find the least count of the ammeter and the voltmeter.

(iii) Make the connections as shown in Fig 8.1 ***Keep the key, K, open while making connections, so that a large current may not pass in the circuit on completing the connections.*** The ends of connecting wires should be cleaned with the help of sand paper.

(iv) Connect the voltmeter across the given resistor in parallel, Positive terminal of the voltmeter should be connected to the end A of the resistor which is connected with the positive terminal of the cell (Fig.8.1). The resistance of the resistor should not be very large or very small.

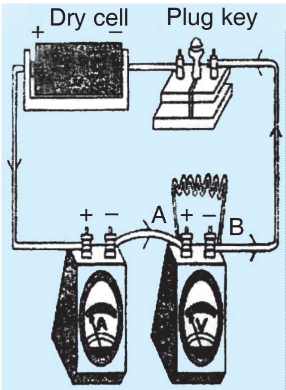


Fig. 8.1: *(a) Experimental setup*

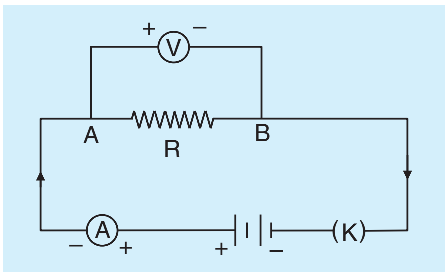


Fig. 8.1: *(b) The circuit diagram*

(v) ***Check that the pointer of the ammeter is at its zero mark when the key K is opened.*** If the pointer does not coincide with zero when no current is flowing, adjust it with the help of the screw provided in it for this purpose. While making this adjustment gently tap the instrument so that pointer may not stick to any position due to friction in its bearings. Check also that the ***terminal of ammeter marked (+) is connected to the positive terminal of the cell.***

(vi) Observe the reading of ammeter using circuit shown in Fig. 8.2 (a) for single cell marked with 1.5 V, ***Remember that the cells should be fresh having its maximum voltage nearly 1.5V.***

(vii) Observe the reading of ammeter using circuit showing in Fig. 8.2 (b) and (c) for two cells and three cells respectively in series, all the cells being identical having emf 1.5 volt.

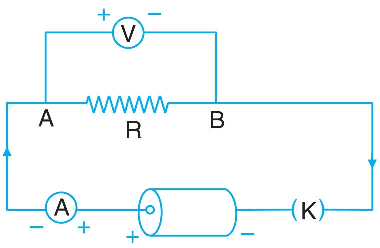


Fig. 8.2 *(a) Circuit Diagram with single cell*

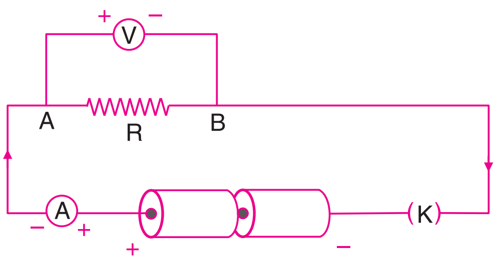


Fig. 8.2 *(b) Circuit Diagram with two cells*

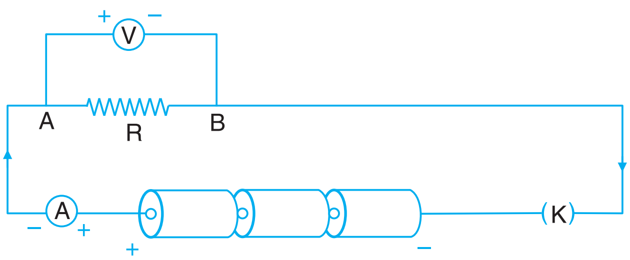


Fig. 8.2 *(c) Circuit Diagram with three cells*

8.3 WHAT TO OBSERVE

Range of the voltmeter = ... to V

Least count of the voltmeter = ... V

Range of the ammeter = ... A to .... A

Least count of the ammeter = ... A.

Table 8.1: Values of current and voltage

S.No.	Voltage in volt *(V)*	Current in ampere *(I)*	*V/I*
1	1.5		
2.	3.0		
3.	4.5		

Mean value of resistance R of the resistor = ... Ω

8.4 ANALYSIS OF DATA

For each observation calculate V/I and record in the table. Plot a graph between V and I taking V on X-axis and I on Y-axis, as shown in Fig. 8.3.

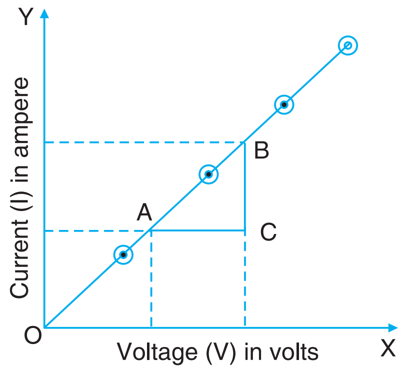


Fig. 8.3: *Graph between V and I*

The graph will be found to be a straight line. Find the slope of this straight-line graph by choosing two points A and B on it

$$\text{slope} = \frac{BC}{AC}$$

The reciprocal of the slope of this graph gives the value of the resistance of the conductor. Extend the straight-line graph backward and check whether it passes through origin (O) or not.

8.5 CONCLUSION

(i) The value of resistance of the conductor = ... ohm.

(ii) The straight line graph indicates that the ratio of V/I is constant and circuit obey Ohm's law.

8.6 CHECK YOUR UNDERSTANDING

(i) An ammeter and a resistor were connected in series with a combination of three cells connected in series. Now, in this system if out of three cells one cell is connected wrongly then what will happen to the reading of ammeter?

(ii) If the reading of ammeter connected in series with a resistor and a cell be *I*, what change will occur to the reading of ammeter; when one more cell is connected in parallel to the first cell?

(iii) Calculate the resistance of the resistor A and B from the following graphs. Fig. 8.4 (a and b).

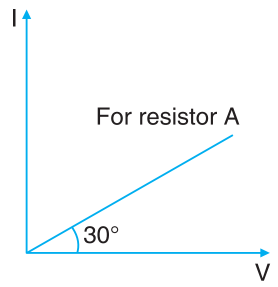


Fig. 8.4 (a)

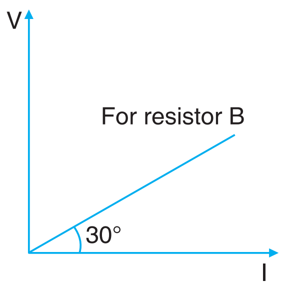


Fig. 8.4 (b)

(iv) You are advised to take out the key from the plug when the observation are not being taken. Why?

(v) Why are you advised to clean the ends of the connecting wires before connecting them?

Errors like straws upon the surface flow: He who would search for pearls must dive below.

– John Dryden

EXPERIMENT 9

To Assemble a Household Circuit Comprising Two Bulbs (3 Volt each), Two Turn On-Off Switches, a Fuse and Two Dry Cells as Source of Power

OBJECTIVES

After performing this experiment, you should be able to:

- *identify the component of a circuit bulbs, switches, fuse, cell etc;*
- *make connections in accordance with the circuit diagram;*
- *differentiate between series and parallel combinations; and*
- *understand that in parallel combination each device/appliance works independently, and at the same voltage.*

9.1 WHAT YOU SHOULD KNOW

If electric potential applied across a bulb is V, the current it draws from the source is given by

$$I = \frac{P}{V}$$

where P is in watt, V in volt and I in ampere.

If P_1, P_2, P_3 .... be the power consumed by different electrical devices connected in a circuit the total power consumption P at any instant is given by

$$P = P_1 + P_2 + P_3 \; ....$$

An electric cell is a device in which a constant potential difference is maintained between its two electrodes immersed in an electrolyte by a chemical reaction. A battery is a combination of more than one cell. Electric fuse is a safety device used in live wire in an electric circuit to prevent from overheating due to overloading or short circuiting. It is a wire of tin-lead alloy of low melting point.

Overloading is the process of overheating of a wire due to excessive current drawn by the appliances connected in a circuit.

An electric circuit is a closed path formed by connecting a battery, a plug key/switch, fuse, a bulb etc through metallic wires for flow of charges.

A switch is an ON-OFF device for current in an electric circuit.

Material Required

Two 3V bulbs with hoders, two (On/OFF) switches, a fuse of connecting wires, a piece of sand paper, four dry cells with a holder to connect four cells in series or battery eliminator providing voltage in steps of 1.5V.

9.2 HOW TO PERFORM THE EXPERIMENT

(i) Observe the circuit diagram 9.1 carefully.

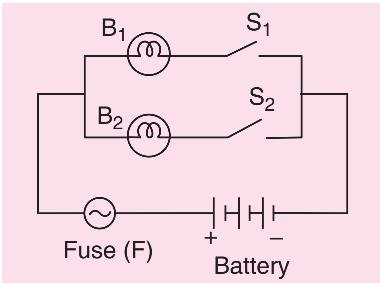


Fig. 9.1 *Circuit diagram for household circuit*

(ii) Observe every component carefully, you will observe every appliance/device has two terminals.

(iii) Take two bulbs B_1 and B_2 and switches S_1 and S_2. Connect bulb B_1 and switch S_1 in series. Similarly connect bulb B_2 and switch S_2.

(iv) Connect bulb B_1 alongwith switch S_1 and bulb B_2 alongwith switch S_2 in parallel with each other as shown in figure.

(v) Connect fuse F of appropriate rating in series with the set up. Connect other terminal of fuse F to the positive terminal of battery/power supply.

(vi) Negative terminal of battery/power supply connect to the second terminal switches S_1 and S_2.

(vii) Press the switches S_1 and S_2 one by one and observe. Record your observation.

(viii) Press both the switches S_1 and S_2 simultaneously and observe. Record your observation.

Table 9.1 Function of switches

S.No.	Switch	ON/OFF	Bulb B_1	Bulb B_2
1.	S_1	ON	ON	OFF
2.	S_2	ON	OFF	ON
3.	S_1 and S_2	ON	ON	ON

9.3 CONCLUSION

Household circuit assembly is completed and both the bulbs B_1 and B_2 can function independently

9.4 CHECK YOUR UNDERSTANDING

(i) If two identical bulbs are connected in series, will they operate independently? Explain

....

(ii) Why do we connect two bulbs in parallel in an electric circuit?

....

(iii) If two identical bulbs are connected in series across a potential difference of 12 V

(a) will they operate at their rated voltage? why.

....

(b) If one bulb fuses, will the other bulb glow?

....

(c) If one identical bulb is connected in series with the two bulbs, what will be the effect on voltage applied across each bulb and current flowing through each bulb?

....

EXPERIMENT 10

To Determine the Speed of a Pulse Propagated through a Stretched String

OBJECTIVES

After performing this experiment you should be able to:

- *create a pulse to travel along the length of a stretched string by giving it transverse jerks;*
- *differentiate between a wave pulse and a periodic wave;*
- *explain propagation of a transverse pulse and a transverse wave; and*
- *differentiate between a transverse wave and a longitudinal wave.*

10.1 WHAT YOU SHOULD KNOW

Wave is a disturbance and wave motion is the motion of the disturbance produced in one part of space travelling up to another part without transfer of any material with the disturbance. Thus, wave motion is a means of transferring energy and momentum from one point to another without any actual transportation of matter between these points. Such waves which can be produced/propagated only in a material medium are called elastic waves or mechanical waves e.g. waves on strings, waves on a slinky, sound waves etc. Another kind of waves which do not require any material medium i.e. the wave which can pass even through vacuum are called non-mechanical electro-magnetic waves e.g. Radiowaves, X-rays, microwaves, ultraviolet rays, visible light, infra red radiation, γ-rays etc.

Wave motion depending upon the direction of motion of the particles of the medium can be classified into two types viz. (i) a transverse wave and (ii) a longitudinal wave. Transverse wave is a wave in which the particles of the medium move to and fro about their mean position perpendicular to the direction of motion of the wave e.g. wave on a string/slinky, light waves, movement of string of a sitar, violin, movement of membrane of a tabla, dholak etc.

Longitudinal wave is a wave in which the particles of the medium move back and forth along the direction of motion of the wave e.g. sound wave travelling through air, vibrations of air column in organ pipes etc.

A wave pulse is a small disturbance in a medium which usually lasts for a short duration e.g., motion of a pulse on a long stretched string or in a stretched slinky. A wave pulse can also be classified as a transverse pulse and a longitudinal pulse according to the direction in which it creates disturbance in the medium.

A transverse pulse is a small disturbance that moves in the medium perpendicular to the direction of motion of the pulse.

A longitudinal pulse is a small disturbance that moves along the direction of motion of the pulse.

To determine the speed of a pulse take a long stretched string with one end fixed and the other end held in your hand. If you snap your hand a little up and down creating a hump in the string near your hand, a sudden pulse created at the end held in hand moves towards the other end along the string with constant speed.

Speed of the pulse along the string is given by $V = \frac{l}{T}$

where l is the length of the string along which transverse pulse travels and T is the time taken by it to travel through length of the string l.

Materials Required

A eight metre long tightly knitted cotton string about half centimeter in diameter, a meter scale or a measuring tape, a stop clock or a stop watch.

10.2 HOW TO PERFORM THE EXPERIMENT

1. Take a tightly knit about eight metre long string. Fix one end of the string to a hook on a wall or to a window grill. Hold a known length of the string (say l_1) firmly with your hand. The string might sag in the centre due to its own weight which will be necessary in creating pulse.
2. Ask your friend to get ready with the stop clock/watch.
3. Give a small transverse horizontal jerk to the string at the end in your hand, to create a transverse pulse. This transverse pulse will travel along the string. Observe the pulse travelling along the string.
4. As the jerk is given to the stretched string to create a pulse, ask your friend to start the stop clock/stop watch to measure the time taken by the pulse to make x number of journeys along the total length of the string between its two ends. Count the number of journeys along the total length of the string carefully.
5. Repeat the experiment with two different lengths of the same string.

10.3 WHAT TO OBSERVE

Least count of the stop clock/stopwatch ....

Least count of given metre scale = ... cm

S.No.	Length of the string between two ends l (cm)	Time taken by the pulse in making x journeys t (s)	Time taken by the pulse for one journey $T = \frac{t}{x}$ (s)	Speed of the pulse $V = \frac{l}{T}$
1.	l_1 = ... m	t_1 = ... s	T_1 = ... s	V_1 = ... ms^{-1}
2.	l_2 = ... m	t_2 = ... s	T_2 = ... s	V_2 = ... ms^{-1}
3.	l_3 = ... m	t_3 = ... s	T_3 = ... s	V_3 = ... ms^{-1}

10.4 RESULT

The speed of a transverse pulse propagated through a stretched string

V_1 = ... ms^{-1}

V_2 = ... ms^{-1}

V_3 = ... ms^{-1}

10.5 CHECK YOUR UNDERSTANDING

1. Why should the string not be placed on a rigid surface?

   ....

2. Why should the amplitude of pulse be appreciably high?

   ....

3. State the factors which affect the speed of a transverse pulse.

   ....

4. Why does the speed of pulse change for different string lengths?

   ....

5. Why is it preferred to take a long string in this experiment?

   ....

EXPERIMENT 11

To Prepare an Aqueous Solution of Common Salt of a Given Composition

OBJECTIVES

After performing this experiment, you should be able to:

- *prepare a solution of known concentration by weighing the solute with a physical balance;*
- *calculate the percentage (%) composition of solutions of known masses of solute and solvent;*
- *calculate the amount of solute to be dissolved in the given quantity of a solvent to prepare a solution of desired percentage composition; and*
- *show the homogeneous nature of solutions.*

11.1 WHAT YOU SHOULD KNOW

Water is known as a universal solvent because it can dissolve many substances. The substances that dissolve in water are called water soluble substances and their solution in water is known as aqueous solution. A solution is defined as a homogeneous mixture of two or more substances. The dissolved substance is called a solute and the water as a solvent in case of aqueous solutions. At a given temperature different amounts of different substances can be dissolved in a given amount of water. By dissolving different amounts of a solute in a definite amount of water you can prepare solutions of different percentage composition. The relationship of mass of solute, solvent and percentage composition can be expressed as given below:

$$\text{Percentage (\%) composition of a solution} = \frac{\text{Mass of Solute Dissolved in gram}}{\text{Mass of Solution in gram}} \times 100$$

Material Required

Beaker or glass tumbler (250 mL), common salt, water, glass rod, measuring cylinder, spatula or spoon, physical balance, weight box, patri dish, glazed paper.

11.2 HOW TO PERFORM THE EXPERIMENT

(i) Take a clean dry beaker or glass tumbler.

(ii) Weigh 5 g common salt on a glazed paper.

(iii) Pour the substance (solid) into a beaker or tumbler and make sure that no solid particle is left on the glazed paper.

(iv) Measure 45 mL water with the help of a measuring cylinder.

(v) Pour the water into the beaker containing the solid substance.

(vi) Stir the contents of the beaker till all the solid substance gets dissolved. Fig. 11.1.

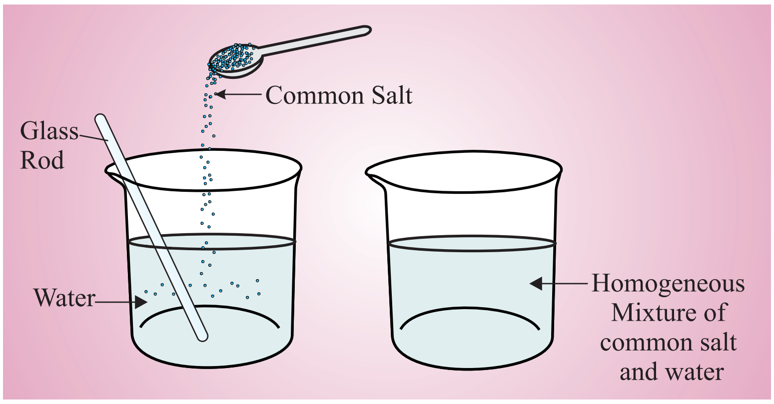


Fig. 11.1: *Making a aqueous solution*

(vii) The required solution (50 mL of 10%) is ready.

(viii) Repeat the experiment by preparing solution of different concentrations.

Table 11.1: Mass of solute and solvent (water) for preparing solutions of different concentration.

Mass of	for 10% solution		for 15% solution		for 20% solution	
solution (g)	Mass of solute (g)	Mass of water(g)	Mass of solute (g)	Mass of water (g)	Mass of solute (g)	Mass of water (g)
50	5	45	7.5	42.5	10	40
100	10	90	15	85	20	80
150	15	135	22.5	127.5	30	120

For ready reference 1 mL water =1 g water because density of water is I g/mL

11.3 CHECK YOUR UNDERSTANDING

(i) Name the solute and solvent in an aqueous solution of common salt.

....

(ii) Why is water called a universal solvent?

....

(iii) Define a solution.

....

(iv) Calculate the percentage composition of an aqueous solution if 150 mL, of it contains 15 g solute dissolved in it.

....

EXPERIMENT 12

Separation of Mixtures

OBJECTIVES

After performing these experiments, you should be able to:

- *choose and employ the evaporation, crystallization and sublimation as techniques for separating mixtures;*
- *separate the components of a given mixture by employing appropriate techniques;*
- *display the laboratory skills for the purification of substances; and*
- *to identify the components of mixtures after separating them.*

12.1 WHAT YOU SHOULD KNOW

Mixtures are formed by mixing two or more substances in any ratio. Based on the nature and properties of mixing substances, mixtures are classified as homogenous and heterogenous. A mixture of common salt or copper sulphate and water is homogeneous in which the dissolved substance is uniformly dispersed throughout the body of the water. The homogeneous mixture of two or more substances is known as solution. On the other hand a mixture of a common salt or naphthalene and sand is a heterogeneous mixture as the substances are non-uniformly dispersed into each other and their particles are distinctly visible. Different techniques like, evaporation, filtrations, crystallization and sublimation are employed for separating the components of mixtures by considering the properties of the components. For example a mixture of salt and water (homogeneous mixture) can be separated by the evaporation of water, copper sulphate can be separated from water by crystallization and a mixture of naphthalene and sand can be separated by sublimation because naphthalene sublimes on heating. Sublimation is a process in which a solid is directly converted to gaseous state from solid state without passing through the liquid phase.

(A) Separation of common salt from water – by evaporation

Material Required

Solution of common salt and water, china dish, burner or spirit lamp, tripod stand, wire gauze, glass rod

12.2a HOW TO PERFORM THE EXPERIMENT

(i) Take about 25 mL salt solution in a china dish. (Fig. 12.1)

(ii) Place the china dish on a wire gauze which is kept on top of a tripod stand.

(iii) Heat the solution gently.

(iv) Keep on heating till all the water has evaporated.

12.3a WHAT TO OBSERVE

Do you find any residue in the chinadish? You will find white salt left behind in the china dish.

12.4a CONCLUSION

Common salt was separated from salt solution by evaporating water.

(B) Separation of copper sulphate from its aqueous solution by crystallization

Material Required

A solution of copper sulphate in water, beaker, burner or spirit lamp, tripod stand, wire gauze, glass rod

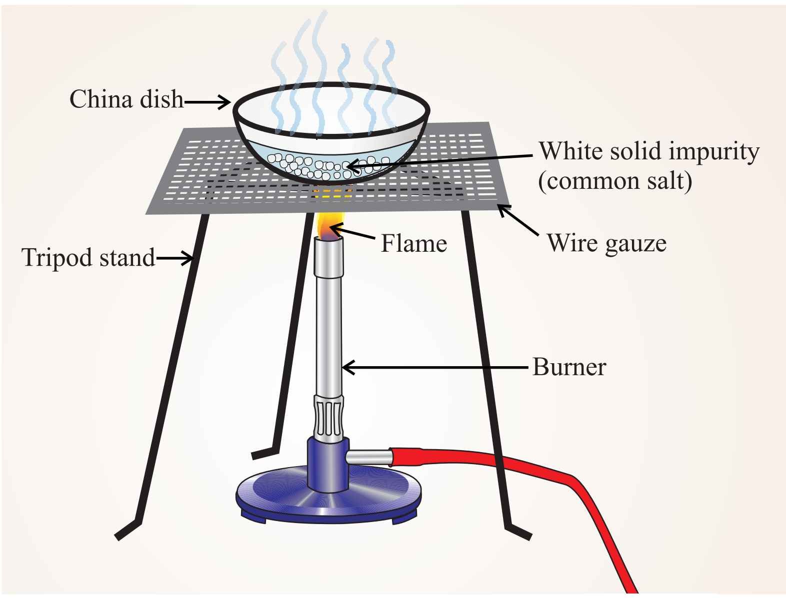


Fig. 12.1 *Evaporation*

12.2b HOW TO PERFORM THE EXPERIMENT

(i) Take about 50 ml, solution of copper sulphate in water in a 250 ml, beaker. It is better-to take a concentrated solution of copper sulphate.

(ii) Place the beaker on a wire gauze kept on the tripod stand.

(iii) Heat the solution gently till the crystallization point is reached (Fig. 12.2)

(iv) Check the crystallization point by dipping one end of the glass rod in the solution and blowing air over it as shown in Fig. 12.3. If any solid deposits at the end of the glass rod it is an indication that crystallization point of the solution has been reached.

(v) Stop heating the solution and allow the Tripod stand contents of the beaker to cool at room temperature by keeping it undisturbed for 4-5 hours Fig. 12.4) copper sulphate will crystallize out slowly.

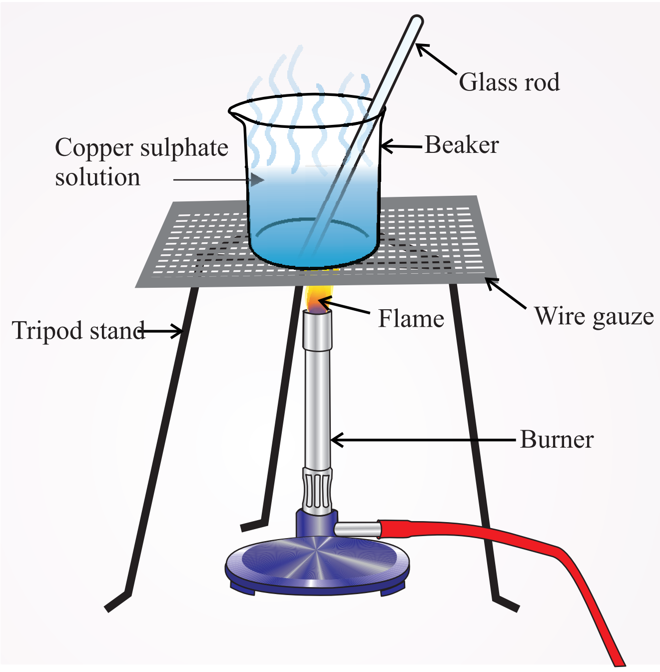


Fig. 12.2 : Concentration of the solution by heating

(vi) The crystals are separated from the mother liquor by decantation as shown in Fig. 12.5.

12.3b CONCLUSION

Copper Sulphate was separated from its aqueous solution by crystallization.

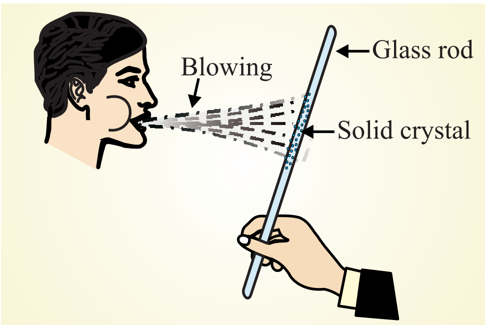


Fig. 12.3 : *Testing of crystallization* point

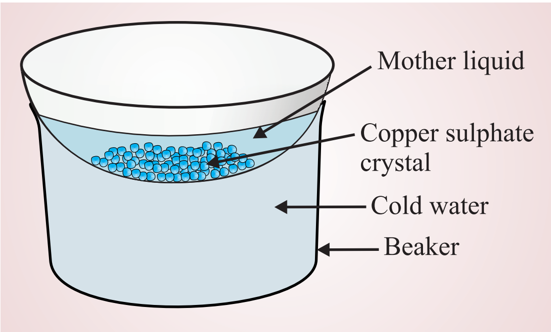


Fig. 12.4: *Cooling the concentrated solution undisturbed for 4-5 hrs to obtain crystals*

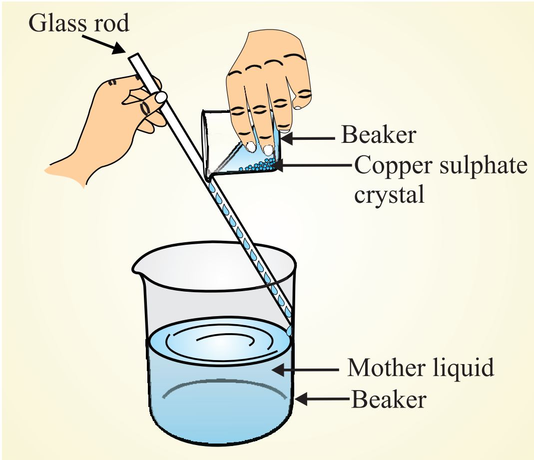


Fig. 12.5 : *Decanting off the mother liquor*

(C) Separation of the Mixture of Sand and Naphthalene by Sublimation

Material Required

Mixture of naphthalene and sand, burner or spirit lamp tripod stand, wire gauze, clay pipe triangle, china dish, cotton

12.2c HOW TO PERFORM THE EXPERIMENT

(i) Take about 5-10 g mixture of sand and naphthalene in a china dish.

(ii) Place the china dish on a clay pipe triangle already fixed on the tripod stand.

(iii) Place glass funnel of appropriate size over the dish in an inverted position.

(iv) Use a cotton plug to close the stem of the funnel from the top.

(v) Heat the mixture gently by using the flame of bunsen burner of lamp. (Fig. 12.6)

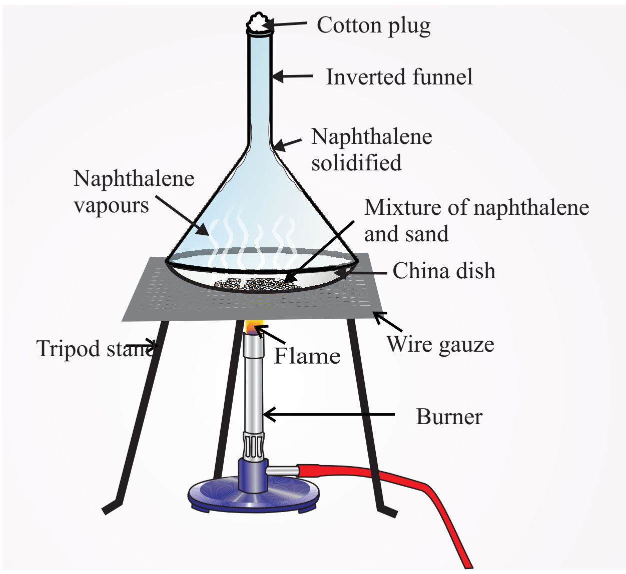


Fig. 12.6 : *Sublimation*

(vi) Naphthalene will sublime (changes solid to gaseous state) and deposit on the cooler walls of the funnel in the form of solid.

(vii) Sand will be left behind in the dish.

(viii) The pure naphthalene can be recovered by scratching it from the walls of the funnel.

12.3c CONCLUSION

Pure naphthalene was separated from a mixture of sand and naphthalene by sublimation.

12.4 CHECK YOUR UNDERSTANDING

1. Which of the following substances are mixtures, one or two rupee coin, air, copper sulphate, common salt, gold ornaments, stainless steel.

   ....

2. Which of the two: (i) muddy water and (ii) rose water is a solution? and why?

   ....

3. Classify the following into homogeneous and heterogeneous mixtures.
   - (i) sea water
   - (ii) sand and sodium chloride
   - (iii) gold ornaments
   - (iv) sugar syrup
   - (v) mixture obtained by passing CO_2 through lime water
   - (vi) mixed vegetables
4. Give an example of sublimation process.

> *Common sense is the collection of prejudices acquired by age 18.*
>
> **– *Albert Einstein***
>
> *The ill and unfit choice of words wonderfully obstructs the understanding.*
>
> **– *Francis Bacon***

EXPERIMENT 13

To Differentiate between a Chemical and Physical Change in a Given Process

OBJECTIVES

After performing this experiment, you should be able to:

- *state the characteristics of physical and chemical changes;*
- *differentiate between physical and chemical changes; and*
- *classify the givern changes as physical or chemical changes.*

13.1 WHAT YOU SHOULD KNOW

A change in which a new substance of different composition and different chemical properties is formed is known as a chemical change. On the other hand physical changes are the changes in which no new substance is formed but only the physical properties of the substance are changed. For example; burning of fuels (like; LPG, kerosene oil, petrol, wood etc.) and making of curd from milk are chemical changes whereas, melting of ice, evaporation of alcohol, water, petrol and other liquids, breaking of glass, etc. are physical changes. All the processes may be classified in terms of chemical and physical changes.

Material Required

Candle, match box, glass slide, chine dish, glass rod.

13.2 HOW TO PERFORM THE EXPERIMENT

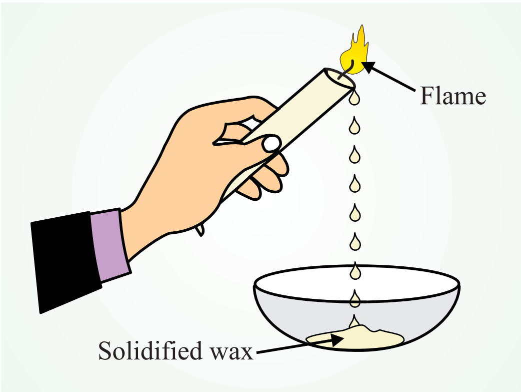
(i) Hold a candle horizontally. Light it with a burning match stick.

(ii) Collect the falling drops of wax in a china dish and observe what happens to the molten wax in china dish. (Fig. 13.1 (a))

(iii) Scratch the solidified wax from china dish with the help of a glass rod. Take a small portion of it and compare it with the wax of original candle by rubbing, and observing its colour.

(iv) Note your observation in the table regarding the type of change.

(v) Bring a glass slide at least 5 cm. above the flame of a burning candle for 2- 3 minutes. (Fig. 13.1(b))



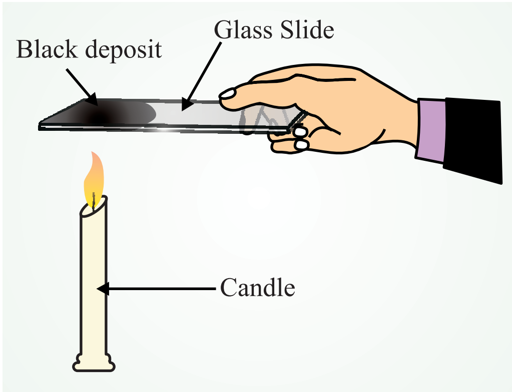


Fig. 13.1 : *(a) Physical change* *(b) chemical change*

(vi) Put off the candle and examine the black deposit on the slide by comparing it with properties of wax of original candle by rubbing, dissolving in water and observing colour.

(vii) Record your conclusions in the table regarding the type of change.

13.3 WHAT TO OBSERVE

Table 13.1: Change in the properties of substance (wax)

S.No	Process	Whether new substance(s) is formed or not	Type of change
1.	Melting of wax		
2.	Burning of wax		

13.4 CONCLUSION

Melting of wax is a .... change, and burning of wax is a .... change.

13.5 CHECK YOUR UNDERSTANDING

(i) Why is melting of wax considered as a physical change?

....

(ii) Why is burning of wax classified as a chemical change?

....

(iii) Classify the following changes as chemical and physical changes.

(a) freezing of water ....

(b) burning of agarbatti ....

(c) rusting of iron ....

(d) glowing of bulb ....

(e) formation of curd from milk ....

(f) vaporization of alcohol ....

(iv) What is meant by (a) a physical change and (b) a Chemical change?

EXPERIMENT 14

To Test the Presence of Water Vapours in Air

OBJECTIVES

After performing this experiment, you should be able to:

- *explain that air is mixture; and*
- *detect the presence of water vapours in air.*

14.1 WHAT YOU SHOULD KNOW

Water vapour is condensed into liquid droplets on cooling.

$$H_2O \text{ (vapour)} \xrightarrow{\text{cooling}} H_2O \text{ (liquid)}$$

Air is a mixture. It contains nitrogen and oxygen as major components. Some other gases are also present in air such as CO_2, water vapours and noble gases. The % of CO_2 and water vapour vary from place to place.

Certain crystalline substances contain water molecules associated with their chemical composition. These water molecules are called water of crystallization and can be removed by heating. Example

$$\underset{\text{Blue}}{CuSO_4 .\ 5H_2O} \xrightarrow{\text{heat}} \underset{\text{Grayish white}}{CuSO_4 + 5H_2O}$$

It water is added to grayish white $CuSO_4$, it change to grayish white blue colour

$$CuSO_4 + 5H_2O \longrightarrow CuSO_4.5H_2O$$

(A) Condensation of water vapours

Material Required

A clean glass tumbler, ice cubes, dry cloth

14.2a HOW TO PERFORM THE EXPERIMENT

1. Take a clean glass tumbler.
2. Wipe out the glass tumbler from outside with a dry cloth to ensure that no water is sticking on its outer surface.
3. Place the ice cubes in the tumbler and keep it for 10 min.

14.3a WHAT TO OBSERVE

You will observe tiny droplets of water appearing on the outer surface of the tumbler (Fig. 14.1)

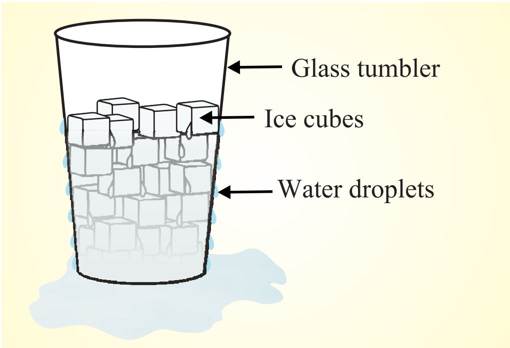


Fig. 14.1: *Showing presence of water in air*

14.4a CONCLUSION

Why do droplets of water appear? It is because water vapours present in air condensed on the cooler parts of glass tumbler. It indicates that the water vapour is present in air.

(B) To confirm the presence of water vapour in air chemically

Material Required

$CuSO_4.5H_2O$, water, test tube, burner/spirit lamp, test tube holder.

14.2b HOW TO PERFORM THE EXPERIMENT

(i) Take 2-3g $CuSO_4.5H_2O$ (blue) in a test tube.

(ii) Heat the test tube.

(iii) The water vapour comes out and condenses at the upper part of the test tube. The $CuSO_4.5H_2O$ present in the test tube has changed to grayish white powder (anhydrous CuSO4 is formed). Fig. 14.2

(iv) Take a small portion of anhydrous $CuSO_4$ on watch glass and wait for some time. It turns blue because anhydrous $CuSO_4$ absorbs water from air.

(v) Add few droplets collected on the glass tumbler to the remaining anhydrous $CuSO_4$ in test tube. It also changes to blue colour.

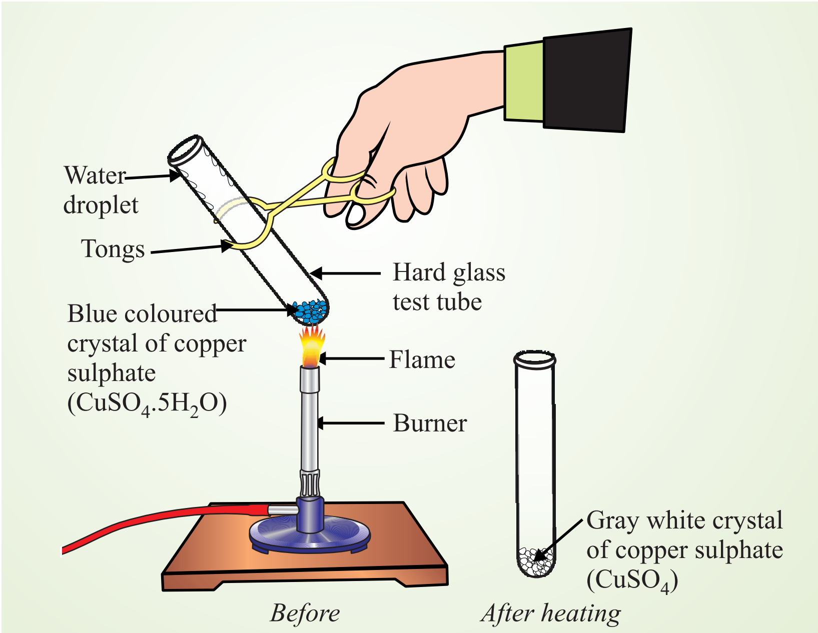


Fig. 14.2 *Heating of $CuSO_4.5H_2O$*

14.3b CONCLUSION

The blue colour of $CuSO_4$ is due to the water of crystallization. Since anhydrous copper sulphate turns blue when exposed to air; water must be present in the atmosphere. Also the liquid droplets collected on the outer walls of the tumbler which turn the anhydrous copper sulphate blue are also water droplets formed by condensation of water vapour in air.

14.4 CHECK YOUR UNDERSTANDING

1. Why are tiny droplets of water collected on outer surface of tumbler containing ice cubes?

   ....

2. Name the chemical compound you can use to detect the presence of water vapour in air.

   ....

3. Anhydrous copper sulphate greyish white if kept in open in the month of July, changes to the blue colour, why?

   ....

4. What is meant by water of crystallization.

   ....

EXPERIMENT 15

To Test the Presence of Carbon Dioxide (CO_2) in Air

OBJECTIVES

After performing this experiment, you should be able to:

- *detect the presence of CO_2 in air; and*
- *explain why lime water turns milky when left exposed to air.*

15.1 WHAT YOU SHOULD KNOW

When carbon dioxide is passed through freshly prepared lime water it turns milky, due to formation of calcium carbonate.

$$\underset{\text{lime water}}{Ca(OH)_2} + \underset{\text{carbon dioxide}}{CO_2} \longrightarrow \underset{\substack{\text{calcium carbonate} \\ \text{(Insoluable in water)}}}{CaCO_3\ (s)} + \underset{\text{water}}{H_2O}$$

If CO_2 is passed for a longer time through lime water, the milky solution becomes clear due to formation of calcium hydrogen carbonate

$$\underset{\text{Insoluble in water}}{CaCO_3 + H_2O + CO_2} \longrightarrow \underset{\substack{\text{Calcium bi-carbonate} \\ \text{(soluble in water)}}}{Ca(HCO_3)_2}$$

Material Required

A bottle, freshly prepared lime water, a cork with two holes, two glass tubes bent at right angles one long and short (delivery tubes)

15.2 HOW TO PERFORM THE EXPERIMENT

1. Take lime water (freshly prepared) in a boiling tube.
2. Fix a cork (having two holes) in the mouth of bottle.
3. Introduce a long bent glass tube through one hole so that its lower end dips in the lime water.
4. Introduce a small bent glass tube through the other hole.

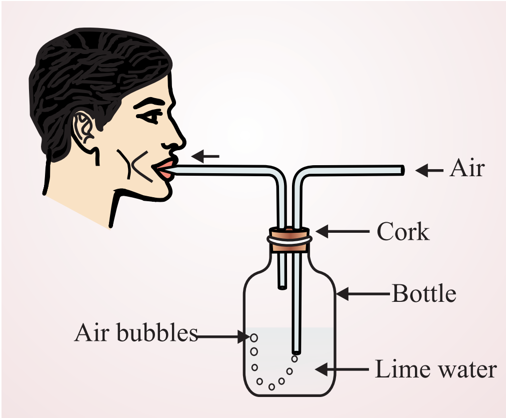


Fig. 15.1 : *Testing presence of CO_2 in air*

5. Suck the air slowly through small delivery tube with the help of your mouth as shown in Fig. 15.1 Due to suction the pressure of the air within the boiling tube is reduced and the fresh air from outside bubbles into the lime water through the long tube dipped in lime water.

15.3 WHAT TO OBSERVE

You will see as air bubbles through the lime water, it turns milky.

15.4 CONCLUSION

Why does lime water turns milky? CO_2 present in air reacts with lime water to form calcium carbonate, it turns lime water milky.

From this observation it is concluded that carbon dioxide is present in air.

15.5 CHECK YOUR UNDERSTANDING

1. Write down the name of calcium compound present in lime water.

....

2. Why does the lime water turn milky when air is passed through it?

....

3. How is lime water prepared?

....

4. What would happen if excess of CO_2 is passed through lime water?

EXPERIMENT 16

To find out the Approximate Percentage of Oxygen in Air

OBJECTIVES

After performing this experiment, you should be able to:

- *show that only particular component of air supports combustion or burning; and*
- *show that air contains oxygen which is about 1/5th of the total volume of air.*

16.1 WHAT YOU SHOULD KNOW

Air is a mixture of gases such as oxygen, nitrogen, carbon dioxide and argon etc. The oxygen and nitrogen constitute 95% of the air and thus are major components. The ratio of oxygen to nitrogen is 1 : 4 in the air. Oxygen is about 20% or 1/5th of the volume of air. Oxygen is the only gas in air which supports combustion.

Material Required

A trough, candle (5-7 cm long), match box, water, ruler, cylindrical tumbler or gas jar.

16.2 HOW TO PERFORM THE EXPERIMENT

(i) Fix the candle in the centre of the plate or trough.

(ii) Take some water upto 1 cm height in the or trough.

(iii) Put some colouring agent such as ink or potassium permanaganate to colour the water.

(iv) Light the candle with the help of burning match stick.

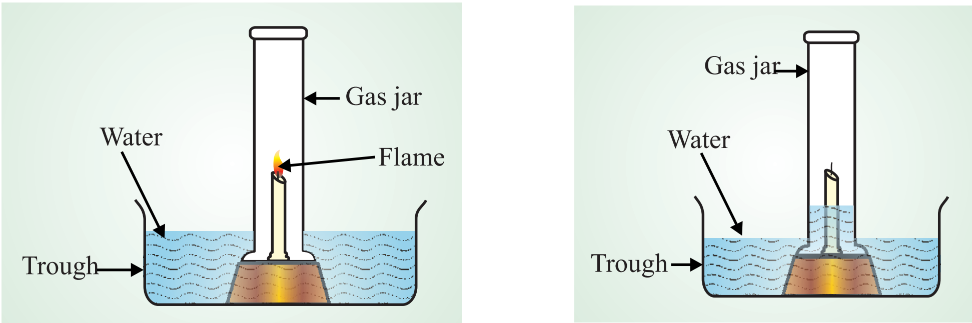
(v) Put the cylindrical tumbler or gas jar in an inverted position while covering the burning candle.

(vi) Keep observing what happens to the flame in couple of seconds.

(vii) Also observe the rise of water in the tumbler or gas jar when the flame of the candle goes off.

(viii) Measure the height of water column in the tumbler or gas jar by using the ruler.

(ix) Compare the height of water column with that of the air column in the tumbler or gas jar and record your observations.



(a) *(b)*

Fig. 16.1 : *Showing presence of oxygen in air(a) Before (b) After*

16.3 WHAT TO OBSERVE

1. The height of water column in the tumbler/gas jar when the flame goes off = ... cm.
2. The height of air column in the tumbler/gas jar when the flame goes off = ... cm.
3. Ratio between observation 1 and observation 2.

16.4 CONCLUSION

The candle flame goes off after consuming whole of oxygen available in the air inside the container covering the flame. The level of water in tumbler/gas jar rises to fill the gap created by the consumed oxygen. The remaining air which is 4/5th of the volume of the container does not support combustion. The portion of the air which was consumed in burning of candle is approximately 1/5th i.e. 20% of the total volume of the container.

16.5 CHECK YOUR UNDERSTANDING

1. Is air a mixture or a compound?

   ....

2. What are two major components of air and what is their ratio?

   ....

3. How much is the percentage of oxygen in air?

....

4. Name two gaseous components of air which do not support combustion or burning.

....

When even the brightest mind in our world has been trained up from childhood in a superstition of any kind, it will never be possible for that mind, in its maturity, to examine sincerely, dispassionately and conscientiously any evidence or any circumstance which shall seem to cast a doubt upon the validity of that superstition. I doubt if I could do it myself.

– Mark Twain

EXPERIMENT 17

To Test the Acidic/Basic Nature of a Solution with the help of pH Paper

OBJECTIVES

After performing this experiment, you should be able to:

- *identify acidic and basic solutions out of the samples supplied to you; and*
- *relate the pH of the solution with acidic/basic character of the solution.*

17.1 WHAT YOU SHOULD KNOW

An aqueous solution contains both H^+ and OH^- ions. The products of their concentrations is always constant. It is equal to 1×10^{-14} mol^2 L^{-2} at 25°C.

$$[H^+]\ [OH^-] = 1 \times 10^{-14} \text{ mol}^2 \text{ L}^{-2}$$

In a neutral solution , the concentration of H^+ ions is equal to that of OH^- ions, i.e.,

$$[H^+] = [OH^-] = \sqrt{1\times10^{-14}} = 1 \times 10^{-7} \text{ mol}^2 \text{ L}^{-1}$$

If the concentration of H^+ ions in the solution is greater than 1×10^{-7}, the concentration of OH^- ions is correspondingly reduced and the solution becomes acidic. On the other hand if the concentration of H^+ ions in the solution is less than 10^{-7}, the concentration of OH^- ions is correspondingly increased and the solution becomes basic.

In 1909, Sorensen introduced the concept of pH for measuring H^+ ions concentration in aqueous solution. **pH is defined as the negative logarithms to the base 10 of the hydrogen ion concentration.**

$$pH = -\log\ [H^+]$$

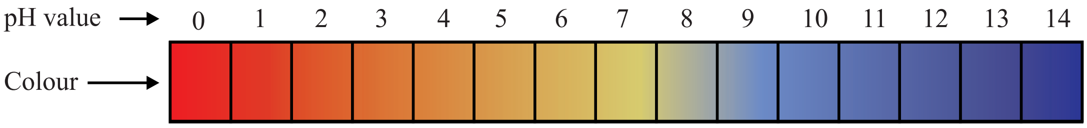
A pH of 7 indicates a neutral solution. pH less than 7, that is, 6, 5, 4, ... etc. indicates acidic solution. pH greater than 7, that is, 8, 9, 10, ... etc., indicates basic solution.

Material Required

Aqueous solutions of sodium hydroxide, ammonium hydroxide, hydrochloric acid, acetic acid pH paper.

17.2 HOW TO PERFORM THE EXPERIMENT

(i) Take a small amount of aqueous solution of sodium hydroxide in a test tube. Take a pH paper and dip it in the solution.



(a) pH Scale

(b)

Fig. 17.1: *pH Paper strips*

(ii) Match the colour developed on the pH paper with the chart given in Fig. 17.1 or provided with pH paper strips and determine the pH of the solution.

(iii) Similarly repeat the above procedure with aqueous solutions of ammonium hydroxide, acetic acid and hydrochloric acid and record your observations.

17.3 WHAT TO OBSERVE

Aqueous solution	Colour developed on the pH paper	pH of the solution	Acidic/Basic
Sodium hydroxide	....	....	....
Ammonium hydroxide	....	....	....
Acetic acid	....	....	....
Hydrochloric acid	....	....	....

17.4 CONCLUSION

It was found that the aqueous solution of

(i) sodium hydroxide is

(ii) ammonium hydroxide is

(iii) acetic acid is

(iv) hydrochloric acid is .

17.5 CHECK YOUR UNDERSTANDING

1. Which ofthe following solutions will have hydrogen ion concentration 1×10^{-7} mol L^{-1}?

   (a) a neutral solution

   (b) an acidic solution

   (c) a basic solution

   ....

2. What is meant by pH of a solution? Arrange the following solutions in increasing value of pH;

   (a) aheutral solution

   (b) an acidic solution

   (c) a basic solution

   ....

3. The concentration of H^+ ions in a solution is 10^{-6} mol L^{-1}. What is the concentration of OH^-ions in it?

   ....

4. Two acids A and B have pH values 1 and 5 respectively. Which is a stronger acid, A or B?

   ....

EXPERIMENT 18

To find the pH of Fruit/Vegetables Juices with the help of pH Paper

OBJECTIVES

After performing this experiment, you should be able to:

- *identify if the fruit juice is acidic, basic or neutral; and*
- *name the fruits which are acidic.*

18.1 WHAT YOU SHOULD KNOW

Same as in Experiment No. 17 (17.1).

Materials Required

Apple, orange, carrot, tomato etc., pH paper

18.2 HOW TO PERFORM THE EXPERIMENT

(i) Take an apple and extract its juice by crushing it and then filtering it. Dip a pH paper in the juice. Observe the colour and compare it with the chart provided in Fig. 17.1 or with the pH paper strtips of the previous experiment and determine the pH of the juice.

(ii) Similarly repeat the procedure with other fruits and vegetables juices. Record your observation.

18.3 WHAT TO OBSERVE

Juice	Colour developed on pH paper	pH of the Juice	Nature Acidic/Basic
Apple	....	....	....
Orange	....	....	....
Carrot	....	....	....
Tomato	....	....	....

18.4 CONCLUSION

The pH of the juices was found an follows:

Apple juice ....

Orange juice ....

Carrotjuice ....

Tomato juice ....

18.5 CHECK YOUR UNDERSTANDING

1. Name two fruits which are acidic in nature.

   ....

2. Name the vegetables which are basic in nature.

   ....

3. How does the pH of a mango change when it ripens?

   ....

Things should be made as simple as possible, but not any simpler.

– Albert Einstein.

The most erroneous stories are those we think we know best - and therefore never scrutinize or question.

– Stephen Jay Gould

I can live with doubt and uncertainty and not knowing. I think it is much more interesting to live not knowing than to have answers that might be wrong.

– Richard Feynman

EXPERIMENT 19

To Identify Washing Soda and Baking Soda out of the two Samples of White Powers

OBJECTIVES

After performing this experiment, you should be able to: ,

- *show the effect of heating on washing Soda and baking soda;*
- *observe the difference in basic nature of washing soda and baking soda; and*
- *observe the action of acetic acid (a vinegar) on washing soda and baking soda.*

19.1 WHAT YOU SHOULD KNOW

An aqueous solution of washing soda is highly basic whereas an aqueous solution of baking soda is mildly basic. On heating washing soda does not decompose however baking soda decom-poses and evolve carbon dioxide. If this gas is passed through lime water, it turns milky.

$$\underset{\substack{\text{Sodium carbonate}\\\text{(washing soda)}}}{Na_2CO_3} \xrightarrow{\text{Heat}} \text{no action}$$

$$\underset{\substack{\text{Sodium bicarbonate}\\\text{(baking soda)}}}{2NaHCO_3} \xrightarrow{\text{Heat}} Na_2CO_3 + CO_2 + H_2O$$

$$\underset{\substack{\text{Calcium hydroxide}\\\text{(lime water)}}}{Ca(OH)_2} + CO_2 \longrightarrow \underset{\text{(Milky white)}}{CaCO_3} + H_2O$$

Material Required

Boiling tubes, test tubes, washing soda, baking soda, acetic acid, phenolphthalein, pH paper, burner, delivery tube, lime water test tube holder.

19.2 HOW TO PERFORM THE EXPERIMENT

(i) Dissolve the given samples in water separately in two test tubes, mark them as A and B.

(ii) Take a small portion of an aqueous solution of both the sample in two test tubes and add few drops phenolphthalein and observe the colour change.

(iii) Take another portion of each solution in test tubes and then add few drops of acetic acid (or vinegar). Note down observation in which case the gas is evolved at a faster rate.

(iv) Dip the pH paper in an aqueous solution of each sample. Note down which is more basic by observing and comparing the colour change of the pH paper with the chart given in Fig. 17.1 or the one provided with pH paper strips.

(v) Take small sample of both the solids in two boiling tubes separately. Heat and pass the evolved gas in lime water one by one. Note down observation in which case the gas evolved turns the lime water milky (Fig. 19.1)

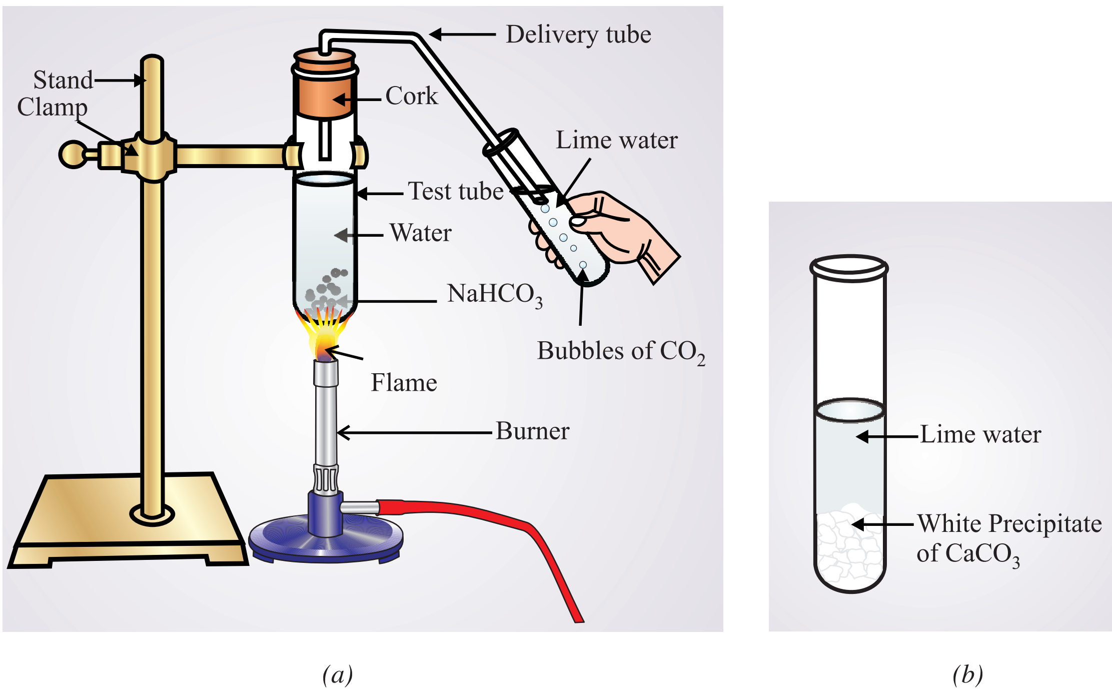


Fig. 19.1: *(a) Heating of baking soda and passing the CO_2 produced through lime water (b) Formaiton of white ppt. of $CaCO_3$*

19.3 WHAT TO OBSERVE

Sample	Phenolphthalein	acetic acid	pH paper	Heating effect	Inference
A					
B					

19.4 CONCLUSION

Aqueous solution of washing soda (sodium carbonate) is stronger base than baking soda (sodium bicarbonate). Sodium bicarbonate evolves CO_2 on heating.

19.5 CHECK YOUR UNDERSTANDING

1. Write the chemical formula of (i) washing soda and (ii) baking soda.

   ....

2. Out of the aqueous solutions of washing soda and baking soda, which one would turn phenolphthalein indicator pink?

   ....

3. Out of washing soda and baking soda, pH of whose aqueous solution is higher?

   ....

4. Which one of washing soda and baking soda would decompose on heating? Give the reaction involved.

   ....

EXPERIMENT 20

To Carry out Chemical Reactions of Different Types

OBJECTIVES

After performing this experiment you should be able to:

- *define what are displacement reaction;*
- *define what are reactions;*
- *define what are (i) decomposition and (ii) displacement reactions;*
- *write equations for the reactions carried out; and*
- *give other examples of decomposition and displacement reactions.*

20.1 WHAT YOU SHOULD KNOW

Chemical reactions can be classified into various types. Combinations reactions are those in which two or more substances combine to form a new substance. In a decomposition reaction, one substance decomposes to from two or more substances. In displacement reaction, one element present in a compound as displaced by another element and in a double displacement reaction, two ionic compounds exchange their ions.

A. Carrying out Combination Reaction

Material Required

Magnesium ribbon, pair of tongs, china dish, burner or spirit lamp

20.2(a) HOW TO PERFORM THE EXPERIMENT

(i) Take small piece of magnesium ribbon (about 4.5 cm long)

(ii) Hold the magnesium wire with a pair of tongs and

(iii) Heat the magnesium wire in the blue part of the flame of burner or spirit lam while keeping a china dish below it. Fig. 20.1

(iv) Collect the white poser formed in the china dish

Fig. 20.1 *Burning of magnesium ribbon*

20.3(a) WHAT TO OBSERVE

The magnesium wire burns with a dazzling flame and a white powder is formed.

20.4(a) CONCLUSION

On heating magnesium combines with oxygen in the air and forms magnesium oxide.

B. Carrying out Decomposition Reaction

Material Required

Lead nitrate crystals, test tube, pari of tongs, burner or spirit lamp

20.2(b) HOW TO PERFORM THE EXPERIMENT

(i) Take about 0.5 g of lead nitrate crystal in a dry test tube

(ii) Hold the test tube with a pair of tongs and heat it strongly in the blue flame of burner or spirit lamp (Fig. 20.2).

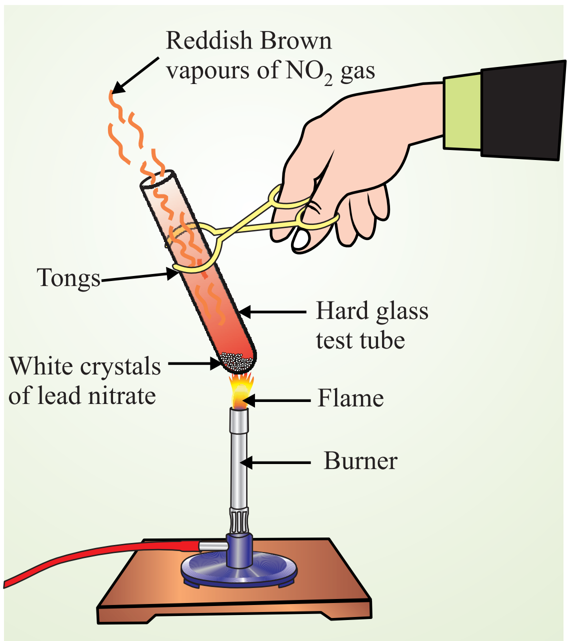


Fig. 20.2 *Heating of lead nitrate*

20.3(b) WHAT TO OBSERVE

Do you find any vapors rising in the test tube?

20.4(b) CONCLUSION

On heating lead nitrate decomposes and reddish brown vapours of NO_2 gas are formed.

C. Carrying out Displacement Reaction

Material Required

Iron nail, aqueous solution of copper sulphate, test tube, test tube stand, sand paper

20.2(c) HOW TO PERFORM THE EXPERIMENT

(i) Take about 3-4 mL of aqueous solution of copper sulphate

(ii) Take an iron nail and clean its surface with a piece of sand paper

(iii) Put the cleaned iron nail in the copper sulphate solution. (Fig. 20.3)

(iv) Keep the test tube in a test tube stand.

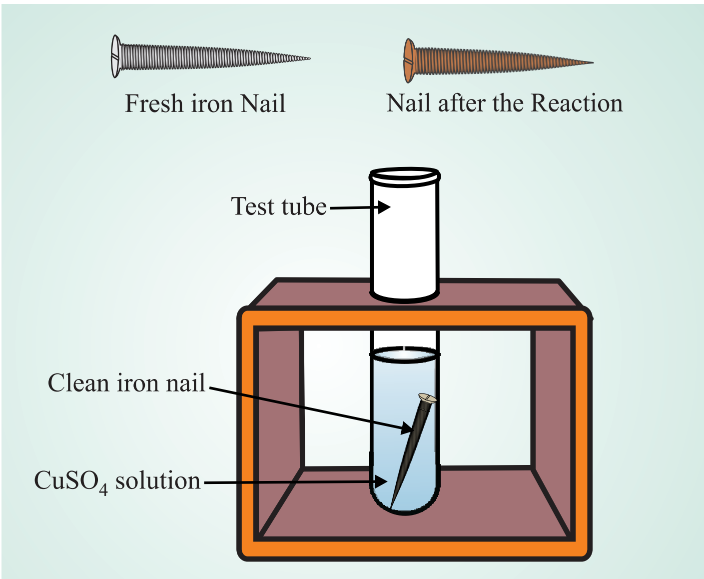


Fig. 20.3 *Displacement reaction between iron and CuSO4 Solution*

20.3(c) WHAT TO OBSERVE

Observe the iron nail dipped in copper sulphate solution.

20.4(c) CONCLUSION

The surface of the iron nail becomes brownish. It is due to displacement of copper from copper sulphate by iron. The liberated copper is deposited on the surface of the nail.

D. Carrying out Double Displacement Reaction

Material Required

Aqueous solution of barium chloride and sodium sulphate and two test tube

20.2(d) HOW TO PERFORM THE EXPERIMENT

(i) Take about 2 mL sodium sulphate solution in one test tube

(ii) Take about 2 ml barium chloride solution in the other test tube

(iii) Add sodium sulphate solution to the test tube containing barium chloride solution. (Fig. 20.4)

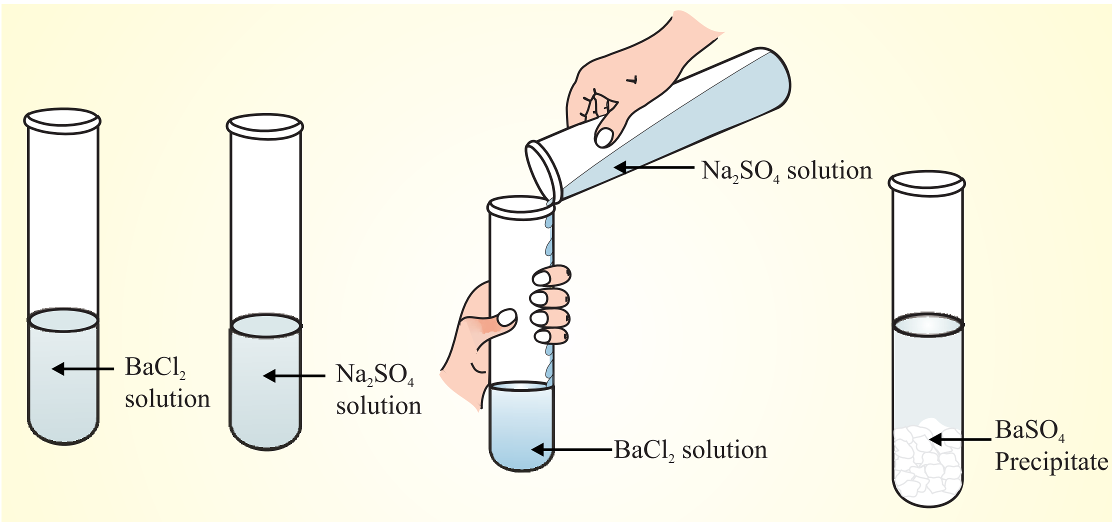


Fig. 20.4 *Double displacement reaction between $BaCl_2$ and Na_2SO_4*

20.3(d) WHAT TO OBSERVE

The appearance of the barium chloride solution when sodium sulphate is added to it.

20.4(d)CONCLUSION

When barium chloride and sodium sulphate solutions are mixed, a milky white precipitate of barium sulphate is formed due to double displacement reaction between them.

20.5 CHECK YOUR UNDERSTANDING

1. Name the compound formed when magnesium burns in air.
2. Write the chemical reaction involved in burning of magnesium.
3. Give an example of combination reaction.
4. Write the chemical equation for the reaction that takes place when lead nitrate is heated

5. Which gas is evolved as brown gas when lead nitrate is heated
6. What is chemical nature of brown deposit formed on iron nail dipped in a solution of copper sulphate?
7. Write balance chemical equation for the reaction that takes place when iron reacts with copper sulphate
8. Identify among the following types to which the reaction between iron and copper sulphate belongs
   (a) combination reaction
   (b) Decomposition reaction
   (c) Displacement reaction
   (d) Double displacement reaction
   (e) Redox reaction
9. What is a precipitate?
10. Name the compound which is formed as white precipitate when barium chloride reacts with sodium sulphate
11. Write the balanced chemical equation for the reaction between barium chloride and sodium sulphate
12. Give two example each of
    (a) Combination reactions
    (b) Decomposition reaction
    (c) Displacement reaction
    (d) Double displacement reactions

EXPERIMENT 21(i)

To Prepare a Temporary Stained Mount of (i) Onion Peel, Observe Under the Microscope and Record Observations

OBJECTIVES

After performing this experiment, you should be able to:

- *acquire the skill of removing thin outer layers from plant material;*
- *prepare a temporary stained mount without trapping air bubbles;*
- *learn to handle and use the microscope such that its light is adjusted and material focused to clarity under low power;*
- *observe a typical plant cell and tally with your theoretical knowledge about the cell and its components; and*
- *distinguish between some components of a plant cell such as the cell wall, cytoplasm, nucleus and vacuole.*

21(i).1 WHAT YOU SHOULD KNOW

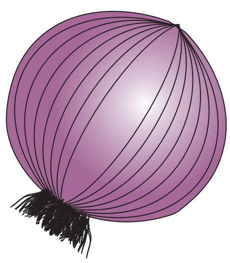
1. A tissue such as that of the onion peel is made of many cells.
2. A cell has many components, some of which like the cell wall, cell membrane, cytoplasm and nucleus can be seen under the compound microscope.

Materials Required

(i) Onion bulbs (ii) Paper toweling/Blotting paper (iii) Dropper (iv) Glycerine
(v) Paint brush (vi) Saffranin solution (for staining) (vii) Petridish

21(i).2 HOW TO PERFORM THE EXPERIMENT

(i) Select an onion bulb, discard the brown dry outer scales.



(ii) Cut the onion into four pieces (quarters) vertically. (See Fig. 21(i).1.1). Remove one fleshy scale.

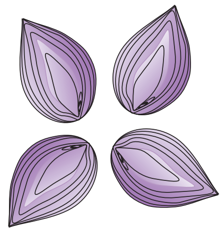


Fig. 21(i).1.1

(iii) Bend the outer (convex) surface of the fleshy scale towards you with your right hand to break it. (Fig. 21(i).1.2)

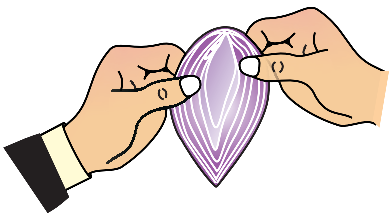


Fig. 21(i).1.2

(iv) It forms a neat break yet it remains attached to the other end of the scale that you are holding with your left hand (See Fig. 21(i).1.3).

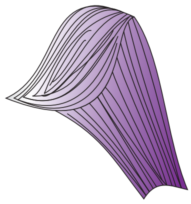


Fig. 21(i).1.3

(v) Gently pull the broken end. You will find that from other half of the scale held in your left hand, a thin transparent layer of epidermis is peeling off easily (See Fig. 21(i).1.4). This is the onion peel. Place it in water in a petridish.

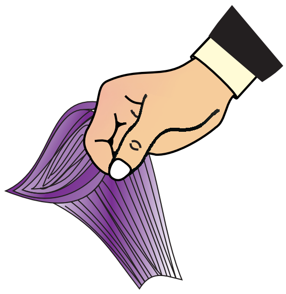


Fig. 21(i).1.4

(vi) If the peel is large, use a fine pair of scissors or a blade to cut a small piece of about 2 mm. To do this, place the peel in a drop of water on a clean slide and trim it.

(vii) If there are any wrinkles in the peel, stretch it with the help of dissecting needle or take another piece of the onion peel.

(viii) Place this neatly cut peel in the centre of a clean slide in a fresh drop of water (Fig. 21(i).1.5) and blot out excess water.

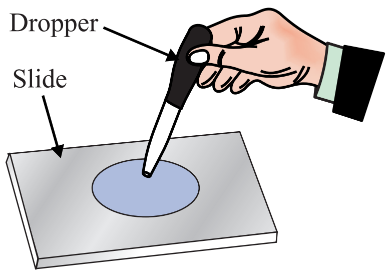


Fig. 21(i).1.5

(ix) Examine the slide under low power (marked 10x on the objective lens) of the microscope (fill up observation 1).

Staining

(i) When you are able to see the epidermal cells clearly in your peel, remove the slide from the microscope.

(ii) Drain off water and then add a drop of Saffranin to the peel on the slide and leave the material in the stain for about two minutes.

(iii) Observe the stained peel under the microscope to check extent of staining. It should neither be too dark nor too light. If it is light, leave in the stain for some more time.

(iv) Pick up the stained material from the slide with a brush, wash it and place it in a drop of glycerine on a fresh slide or carefully wash off extra stain with the help of a dropper or a trickle from the tap. Add a drop of glycerine to the stained peel preparation and gently place the cover slip.

(v) Hold the cover slip with your left hand at 45° (as shown in the diagram 21(i).1.6) on the slide in such a way that the lower edge of the coverslip touches the glycerine. Now using the needle, gradually lower the cover slip so that no air bubble gets trapped in the material. Excess glycerine should be removed with the help of a blotting paper.

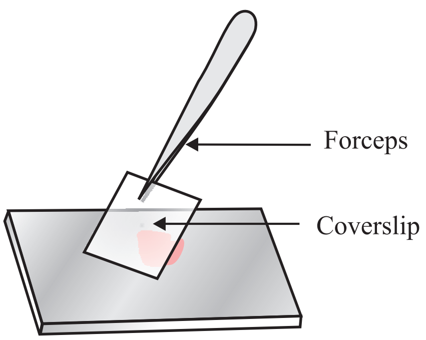


Fig. 21(i).1.6 *Placing the coverslip*

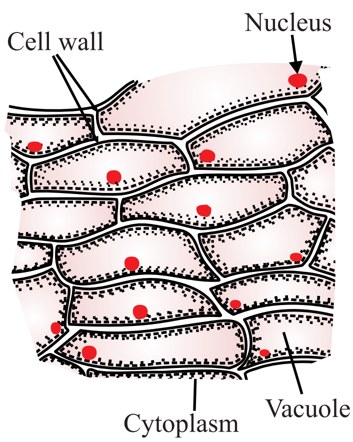


Fig. 21(i).1.7 *Epidermal cells in onion peel*

The onion peel mounted on the slide is now ready for further observation (fill up observation 2).

(vi) Observe under the microscope and compare the diagram provided (Fig. 21(i).1.7) with the slide preparation as seen under the microscope.

PRECAUTIONS

1. Do not leave the peel too long in air, otherwise it will dry and show air bubbles in the slide.

2. The peel should be mounted in the centre of the slide.
3. Always use a brush (not a needle) to transfer the peel from the petridish to the slide or from one slide to another. Otherwise, the peel will tear off.
4. Avoid the entry of any air-bubbles in the mount.
5. Use clean slides and cover slips for mounting.

21(i).1.3 RECORDING OF OBSERVATION

Observation 1

Under low power of the microscope

(i) What can you see? (Long rows of rectangular cells in the unstained onion peel)

....

(ii) Which structures of the cell can you see? Do you see the cell wall, the nucleus and a large vacuole contained in the cytoplasm?

....

Observation 2

After staining the onion peel

(i) Do you see large number of cells in the peel or only one? What is the general shape of these cells (rectangular, circular, triangular, polygonal etc)?

....

(ii) What is the darkly stained body in each cell?

....

(iii) Can you see any vacuole in the cell cytoplasm?

....

(iv) Does the nucleus become more conspicuous after staining?

....

(v) What is the position of the cytoplasm in the cell? (central or peripheral)

....

(vi) What is the shape of the nucleus? (spherical, oval, irregular etc.)

....

(vii) Sketch the onion peel cell as seen under the microscope. Label the parts such as the cell wall, cytoplasm, vacuole and nucleus.

....

(viii) Draw the cell and record the procedure, observations etc, in your record book as per format given in your practical manual in the beginning.

EXPERIMENT 21(ii)

To Prepare a Temporary Stained Mount of Human Cheek Cells, Observe under the microscope and Record Observations

OBJECTIVES

After performing this experiment, you should be able to:

- *acquire the skill of removing few human cheek cells;*
- *prepare a uniform smear; and*
- *observe the special features of squamous epithelium.*

21(ii).1 WHAT YOU SHOULD KNOW

1. Animal cell lacks cell wall and the large vacuole seen in a plant cell.
2. Epithelial tissue forms covering of organs and is of various types, one of which is squamous epithelium.
3. Inner lining of the cheek is made of squamous epithelium. These cells are (a) flat (b) closely packed and (c) each cell has a a central nucleus.

Materials Required

(i) Slides	(ii) Cover slips	(iii) Filter-papers	(iv) Needles
(iv) Needles	(v) Methylene blue	(vi) Paintbrush	(vii) Tooth pick.

21(ii).2 HOW TO PERFORM THE EXPERIMENT

(i) Take a washed tooth pick and gently slide its tip over the inner lining of your cheek. Its tip would collect some viscous transparent substance. Smear this substance on a slide. (Instead of tooth pick, you can use the uncoated end of a matchstick).

(ii) Add a drop of water to the smear and also a drop of Methylene Blue stain.

(iii) Leave for about one minute.

(iv) Tilt the slide to let the extra stain drain off. Wash the slide by gently allowing the water to trickle down the slide.

(v) Put a cover slip gently over the material with the help of a needle avoiding entry of any air bubbles.

(vi) Press it gently with a needle to make the cells under the cover slip spread out uniformly.

(vii) Soak away extra stain by placing the slide within a folded filter paper, taking care not to move the cover slip.

(viii) Observe under a microscope and find out the structural details of squamaous epithelium (Fig. 21(ii).1.1)

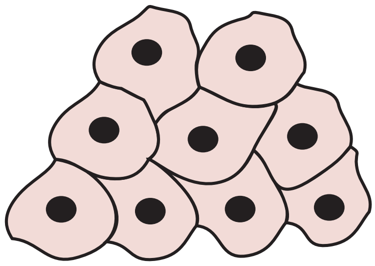


Fig. 21(ii).1.1 *Cheek cell*

PRECAUTIONS

1. Scrape the inner surface of the cheek gently to avoid any damage or bleeding.
2. See that you do not break the cover slip.
3. While removing the extra stain, make sure you do not move the cover slip and disturb the material under it.

21(ii).3 RECORDING OF OBSERVATION

Observations

Observe the cheek cells under the microscope:

(i) Draw a few cells in your record book as you see them.

....

(ii) What is the shape of cheek cells?

....

(iii) What is the location of nucleus in a cheek cell?

....

(iv) List the differences between the cells you see in this exercise (cheek cells) and the cells you saw in onion peel with respect to the following:

(a) Presence or absence of cell wall:

....

(b) Presence or absence of large vacuole:

....

(c) Difference in shape:

....

(v) Is there any cell wall in the cheek cells? Why or why not?

....

(vi) Cheek cells are epithelial cells. What is the name of this kind of epithelium?

....

EXPERIMENT 22

To Study and Draw Different Types of Plant and Animal Tissues with the Help of Permanent Slides : Plant tissues: Parenchyma and Sclerenchyma; Animal tissues: Blood, Striped muscle fibres and Nerve cells

OBJECTIVES

After performing this experiment, you should be able to:

- *identify and differentiate between different kinds of plant and animal tissues on the bases of their size, shape and some structural details; and*
- *differentiate between different types of blood cells.*

22.1 WHAT YOU SHOULD KNOW

- Plants and animals have different types of tissues which perform specific functions
- Each tissue has special features suited to its function

22.2 HOW TO PROCEED

- Gently wipe the permanent slide with a soft tissue paper in order to clean the dust particles, if any, on the slide.
- First examine the slide under the low power of the microscope.
- Move the slide to get a general view of the entire slide.
- Change to high power, if required, by using fine adjustment only.
- Draw and record your observations. Repeat the same procedure for all the slides.

1. To study the plant tissues from permanent slides

(a) PARENCHYMA

- Parenchyma cells are relatively large, thin walled and globular with prominent nuclei.
- The cells are arranged loosely so that there are intercellular spaces among them. These spaces improve the gas-exchange capacity of tissue for photosynthesis.

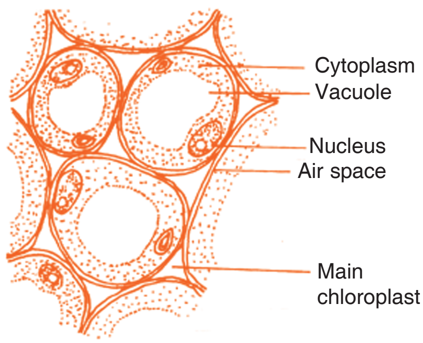


Fig. 22.1 *Parenchyma*

- Parenchyma tissue is composed of cells of only one type, hence is called a **simple tissue.**

(b) SCLERENCHYMA

- Sclerenchyma cells have thick, lignified secondary walls which make sclerenchyma tissues hard, rigid, and somewhat brittle.
- Sclerenchyma cells are dead cells with no intercellular air spaces.

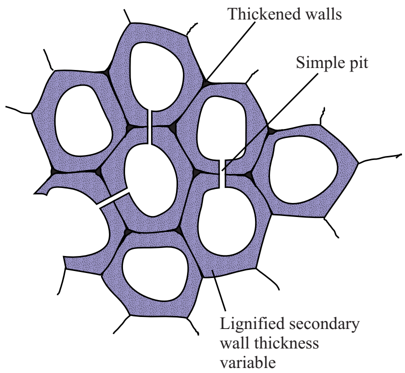


Fig. 22.2 *Sclerenchyma*

Note: The distinction between parenchyma and sclerenchyma is largely based on the wall structure. Parenchyma cell walls are usually thin and primary while in sclerenchyma a secondary wall is formed on the inner side of the primary wall. Secondary walls are those, which develop after the cells have ceased to enlarge.

2. To study the animal tissues from permanent slides

(a) Blood:

On examining the slide of blood under the microscope the following structures will be observed:

- A large number of circular concave disc like structure, which have no nuclei. These are red blood cells (RBCs).

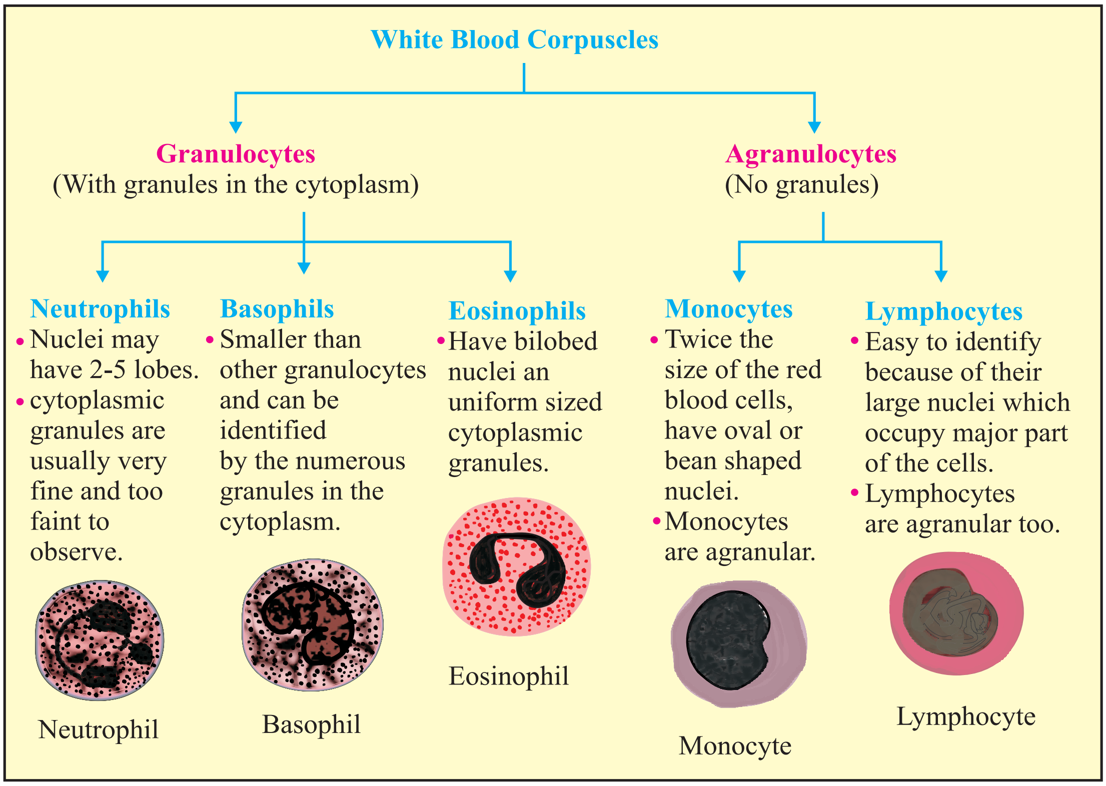


Fig. 22.3 *White blood corpuscles*

- Fewer number of stained larger cells (larger than RBC), irregular in shape, with a nucleus of various shapes. These are white blood cells (WBCs). There are five types of white blood cells. The different WBC that you see are neutrophils, monocytes, lymphocytes, basophils and eosinophils.

(b) Striped muscle fibres are also known as **skeletal muscle** or **striated muscle fibres:**

- These are elongated, cylindrical fibres.
- Nuclei are peripheral and cells multinucleated.
- They have alternating bands perpendicular to the long axis of the cell. These cells function in conjunction with the skeletal system for voluntary muscle movements. The bands are areas of actin and myosin proteins.

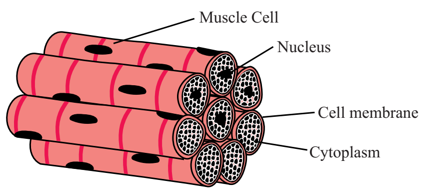


Fig. 22.4 *Muscle fibre*

(c) Nerve cells:

- The cell body of a nerve cell (also called **soma)** is basically a nucleus surrounded by cytoplasm.
- Extending out from each nerve cell body are long cytoplasmic processes, **one axon** and **several dendrites.**
- Nuclei of nerve cells are large and round.
- Cytoplasm of nerve cell bodies is abundantly supplied with masses of rough endoplasmic reticulum (called **Nissl body).**

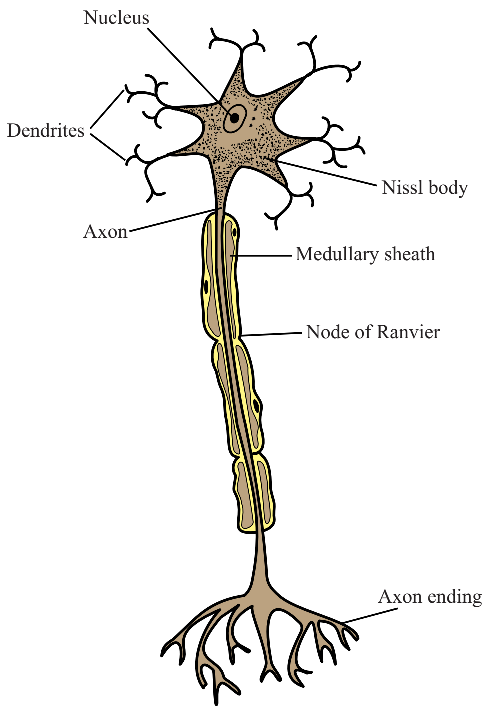


Fig. 22.5 *Nerve cell*

EXPERIMENT 23

To Study the Process of Osmosis through a Semipermeable Membrane

OBJECTIVES

After performing this exercise, you should be able to:

- *learn to prepare a concentrated solution of salt/sugar;*
- *identify the properties of a semi permeable membrane; as opposed to a permeable membrane, a semipermeable membrane permits only certain substances to pass through it);*
- *conclude that the cellophane paper has invisible pores and is not impervious to water; and*
- *conclude that living cells such as fresh potato cells are semipermeable.*

23.1 WHAT YOU SHOULD KNOW

All living cells contain water. It is essential for all activities of the cell. Each cell is surrounded by a cell membrane, which is selectively permeable. It allows water and some selective substances to move across it. The water in the living cells has some salts dissolved in it.

In all living cells, water moves across the cell membrane from the region of its higher concentration to the region of its lower concentration. This process is called osmosis. No energy is consumed during osmosis.

Material Required

(a) **Thistle funnel method:** one thistle funnel, two beakers, glass rod for stirring, retort stand, dropper, thread, cellophane paper/parchment paper as a Semipermeable membrane, common salt/sugar, water.

(b) **Using a potato or carrot:** one raw potato or carrot, one beaker, one trough, glass rod for stirring, dropper, common salt/sugar, cork borer and water.

23.2 HOW TO PERFORM THE EXPERIMENT

(a) By thistle funnel method

(i) Add 1-2 teaspoonfuls of sugar/salt to about 50 mL water in a beaker. Stir well with the help of a glass rod until the sugar or salt gets dissolved in water. Keep adding sugar/salt until no more gets dissolved in it. A **saturated solution** is ready.

(ii) Cover the mouth of the thistle funnel with a piece of cellophane paper. Fix the cellophane on to the mouth of thistle funnel firmly with the help of a thread. Make sure that it is air-tight.

(iii) Half-fill a beaker with water.

(iv) Dip the mouth of the thistle funnel in the beaker filled with water.

(v) Clamp the stem of thistle funnel on the retort stand. Adjust the position of the thistle funnel so that it does not touch the bottom of the beaker. Use some padding of cotton wool or paper for firm clamping of the thistle funnel to the stand. This is to avoid breakage of the stem of the thistle funnel.

(vi) Gently pour the concentrated solution into the thistle funnel through the small opening at the end of its stem. The solution should completely fill the thistle funnel and some part of its stem. In case of difficulty in pouring, you may use a dropper.

(vii) Mark the initial level of the concentrated solution in the stem of the thistle funnel with the help of a marker pen.

(viii) See figure 23.1 to check if your apparatus is set properly.

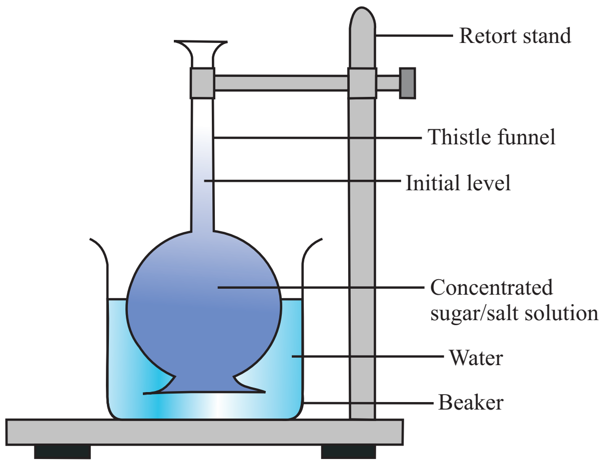


Fig. 23.1: *Set-up to study osmosis by the thistle funnel method*

(ix) Leave the apparatus undisturbed for 1 hour.

(b) By using a potato/carrot

(i) Peel the skin of a raw potato or carrot with a scalpel.

(ii) Slice a thin piece from one end (bottom) of the potato or carrot so that a flat base is formed for the potato or carrot to balance and stay up.

(iii) Using a cork borer, make a pit in the centre of the potato or carrot from the top. *Take care not to make a hole but a pit.*

(iv) Place the potato or carrot in a petridish or a glass trough containing water such that the potato or carrot is only half-immersed. Take care that the open mouth of pit faces up.

(v) Prepare a concentrated sugar solution in another beaker as in step (i) of thistle furinel method.

(vi) Half-fill the potato pit with sugar solution and mark the level with a ball point pen.

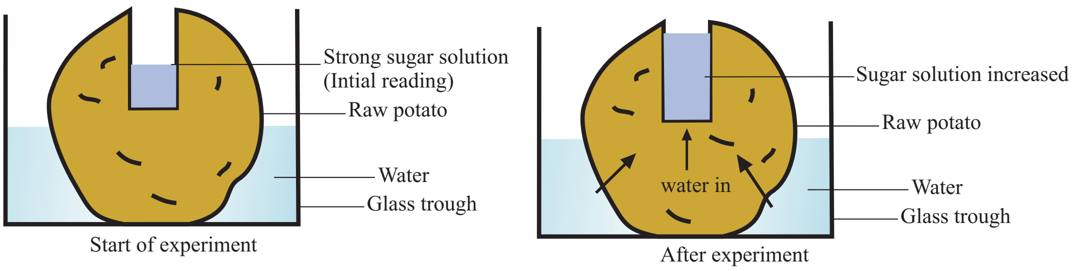


Fig. 23.2: *Set-up to study osmosis using a potato*

(vii) See figure 23.2 to check if your apparatus is set correctly.

(viii) Leave the set-up undisturbed for 1 hour.

This is called the **Potato Osmometer.**

23.3 WHAT TO OBSERVE

(i) Initial level of the solution in the stem of thistle funnel (or in the potato or carrot pit) ....

(ii) Observe the level of the solution in the stem of the thistle funnel (or in the potato or carrot pit) one hour after setting up of the apparatus. Do you observe any change?

(iii) Has the level of the solution gone up?

If yes, record it..

If not, wait for some more time (about 30-45 minutes) and repeat your observation.

(iv) If yes, can you explain your observation?

(v) Where is the region of higher concentration of water, in the beaker of water or sugar solution? So which way should water move from that in beaker into the sugar solution or from sugar solution in the potato pit to the beaker?

Hint: Read the definition of osmosis given under "What you should know" and answer the above question.

23.4 INFERENCE/CONCLUSION

After one hour, the level of solution in the thistle funnel (or the pit) rises up. Since cellophane paper (or the cells lining the pit) acts as a semi-permeable membrane, it shows that water has moved from the beaker (region of lower sugar/salt concentration into the thistle funnel or the pit (region of higher sugar/salt concentration or lower water concentration). In other words, osmosis has taken place.

23.5 CHECK YOUR UNDERSTANDING

(i) If you take concentrated solution in the beaker and water in the thistle funnel, (or in the potato or carrot pit) what would you observe?

....

(ii) What would happen if the beaker contained a less concentrated solution (say half teaspoonful sugar/salt in 100 ml water) and the thistle funnel (or the pit) contained more concentrated solution (say two teaspoonful sugar/salt in 100 ml water)? Will the level of solution in the thistle funnel (or the pit) lower, or higher or the same?

....

(iii) Suppose you tied muslin cloth at the mouth of the thistle funnel instead of the cellophane paper and performed the same experiment. What would have been the result?

....

(iv) What will happen to the level of water in the thistle funnel if you use polythene sheet instead of cellophane paper?

....

(v) You must have observed that when a pinch of salt is sprinkled on some freshly cut vegetables, water oozes out of them. What is the reason?

....

(vi) Give two examples of Osmosis from your day-to-day life, other than those discussed here.

....

EXPERIMENT 24

To Test the Presence of Starch in Green Leaves Exposed to Sunlight

OBJECTIVES

After performing this experiment, you should be able to:

- *understand that sunlight is necessary for photosynthesis;*
- *test the presence of starch in leaves as a product of photosynthesis; and*
- *handle apparatus and chemicals in the laboratory with care.*

24.1 WHAT YOU SHOULD KNOW

Green plants manufacture their food by using CO_2 and H_20 in the presence of sunlight. This process is known as **photosynthesis.** One of the end products formed during this process is stored in the storage tissue of plants in the form of starch.

Material Required

(i) Beaker 500 ml capacity
(ii) Test tube
(iii) Forceps
(iv) Tripod stand
(v) Wire gauge
(vi) White ceramic tile
(vii) Dropper
(viii) Ethanol (alcohol)
(ix) Iodine solution
(x) Water
(xi) Two potted plants – one kept in the dark for two days and other in sunlight

24.2 HOW TO PERFORM THE EXPERIMENT

(i) Take a leaf from a potted plant which has been kept in the sunlight for a few hours.

(ii) Take a beaker and half fill it with water.

(iii) Place the beaker on a tripod stand which is fitted with wire gauge.

(iv) Light the burner and allow the water to boil.

(v) Put the leaf in the boiling water for about 1-2 min.

(vi) Half-fill a test tube with ethanol. Ethanol is highly inflammable so do not take it near the flame.

(vii) With the help of forceps take the boiled leaf out of water and transfer it to the test tube containing ethanol.

(viii) Place this tube in the beaker containing boiled water.

(ix) Now keep this apparatus on the tripod stand and boil the water again. This forms a water bath. Soon ethanol in the tube also starts boiling. Put off the burner. Chlorophyll gets extracted by ethanol. If chlorophyll is not extracted before performing starch test, then because of its green colour it would be difficult to see that starch turns Iodine blue black.

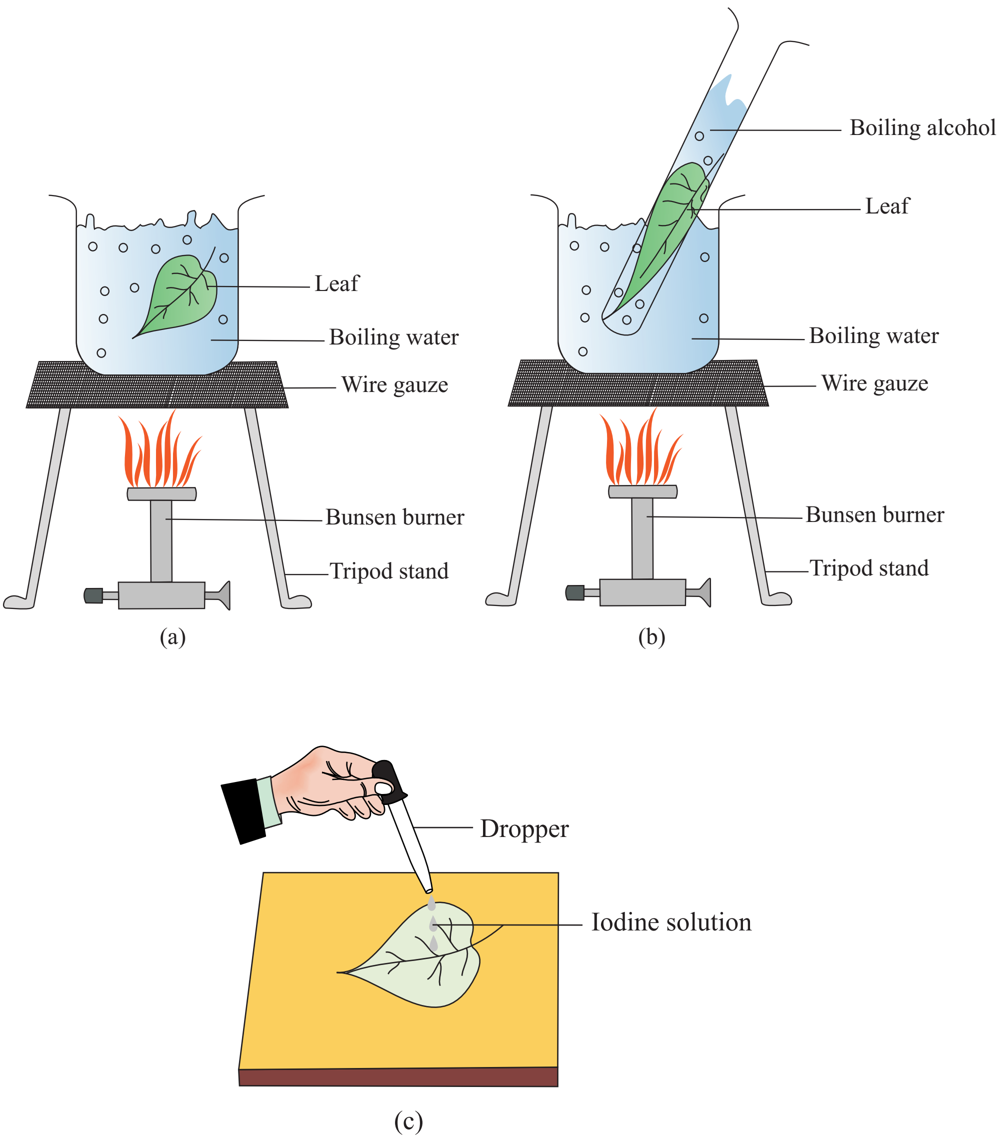


Fig. 24.1 *Set up to test the presence of starch in a leaf*

(x) Take the leaf out of the ethanol with the help of a pair of forceps and dip it in hot water to soften it.

(xi) Spread the leaf on a white tile and cover it with iodine solution with the help of a dropper and observe.

(xii) Now take a leaf from the similar plant kept in the dark for a least 24-48 hours and repeat the steps (ii) to (xi) and observe.

PRECUATIONS

1. Destarch the plant by keeping the plant in darkness, in the experiment to show that sunlight is necessary for photosynthesis.
2. Chlorophyll must be extracted before testing for starch with iodine.
3. Ethanol being volatile and inflammable, test tube containing alcohol should be heated on water bath.

24.3 WHAT TO OBSERVE

Observe the blue black colour of iodine solution on the boiled leaf. This confirms the presence of starch in green leaves of plants, as starch is known to turn Iodine blue-black.

24.4 CONCLUSION

Presence of starch in the leaf from the plant kept in sunlight and no starch formation in plant kept in darkness indicates that photosynthesis has occurred and starch is formed only in the presence of sunlight.

24.5 CHECK YOUR UNDERSTANDING

(i) Why is it essential to boil the leaf in water first and then in ethanol?

....

(ii) Why is it necessary to boil the ethanol tube in the water bath?

....

(iii) Write a word equation and then complete chemical equation of photosynthesis.

....

(iv) At what time of the day does photosynthesis occur in a plant cell?

....

(v) Which conditions are necessary for photosynthesis?

....

EXPERIMENT 25

To Observe that Oxygen is Released during the Process of Photosynthesis

OBJECTIVES

After performing this experiment, you should be able to:

- *show that oxygen is released during the process of photosynthesis; and*
- *give the chemical equation for photosynthesis.*

25.1 WHAT YOU SHOULD KNOW

All green plants synthesize their own food, in the form of sugar in presence of sunlight using water and CO2. This process is known as ***photosynthesis.***

The chemical equation for photosynthesis is shown below:

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6H_2O + 6O_2$$

Oxygen (O_2) is a by-product of photosynthesis. All living organisms use this oxygen for respiration.

Material Required

(i) A beaker (ii) A funnel (iii) A match box

(iv) A test tube, (i)twigs of an aquatic plant *(Hydrilla/Wolffia/Vallisneria)* or any other plant whose leaves remain submerged in water.

25.2 HOW TO PERFORM THE EXPERIMENT

(i) Take a beaker and fill it with pond water or tap water. Add a pinch of baking soda (Sodium-bi-carbonate) to it.

(ii) Take some twigs of water plants such as *Hydrilla/Wolffia/Vallisneria* etc. tied together at their cut ends with a thread.

(iii) Insert these twigs into the wide mouth of the funnel. Align the twigs such that the cut ends face the neck of the funnel. Place the funnel inside the beaker with its wide mouth facing downward. *Ensure that the ‘funnel is fully submerged under the water.*

(iv) Fill a test tube up to the brim with water and invert it over the stem of the funnel. While inverting, close the mouth of the test tube with your thumb to ensure that no air bubbles enter the test tube.

(v) See figure 25.1 to check if your apparatus is correctly set.

(vi) Place the apparatus in sunlight or in front of a table lamp for about 30-40 minutes.

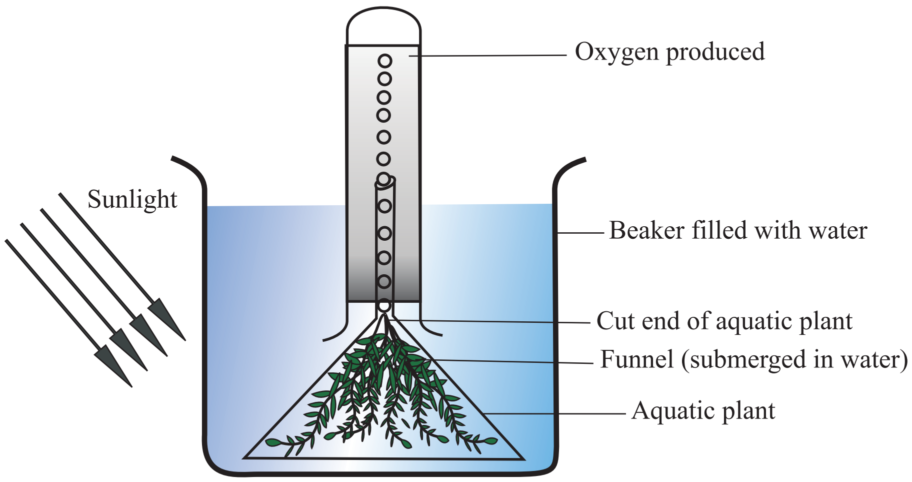


Fig. 25.1: Set-up to observe that oxygen is liberated during the process of photosynthesis

25.3 WHAT TO OBSERVE

(i) Observe the water in the test tube inverted on the stem of the funnel. Do you observe any bubbles rising up?

(ii) Count the number of bubbles rising up per minute. Record your observations in the table given below.

Table: To record the number of bubbles liberated after different time period

S. No.	Time	No. of bubbles liberated	No. of bubbles liberated per minute = Total no. of bubbles liberated ÷ Time (min) taken
1	1st min		
2	2nd min		
3	3rd min		
4	4th min		

The average number of bubbles liberated per minute ....

(iii) What happens to the level of water in the test tube after 5 minutes? ....

(iv) Gently remove the test tube closing it by thumb. Invert the test tube and bring a burning matchstick near the mouth of the test tube immediately after removing your thumb.

What do you observe? ....

Did the matchstick glow brighter or did the flame fade away? ....

This is because of the oxygen gas present in the test tube. Oxygen helps in burning of substances.

25.4 INFERENCE/CONCLUSION

Oxygen is produced during photosynthesis.

25.5 CHECK YOUR UNDERSTANDING

1. What will happen if you place the apparatus in the dark?

   ....

2. If no bubbles are evolved, what does it indicate?

   ....

4. Where do you think the plant obtained carbon-dioxide from?

   ....

PRECAUTIONS

1. Clean the glass apparatus before setting up the experiment.
2. Fully submerge the funnel into water.
3. Ensure that there are no air bubbles in the test tube.

EXPERIMENT 26

To Show that CO_2 is Given Out During Respiration

OBJECTIVES

After performing this experiment, you should be able to:

- *understand that CO_2 is given out during respiration;*
- *reason out why germinating seeds and not dry seeds are selected; and*
- *explain that the rate of respiration is higher in germinating seeds than in non-germinating ones*

26.1 WHAT YOU SHOULD KNOW

- All living beings respire whether it is a developing baby plant (germinating seeds) or a developing human foetus, or a single cell or a fully developed individual. During respiration oxygen is taken in while carbon dioxide is given out.
- O_2 taken in is used for oxidation of food to release energy

Materials Required

(i) Conical flask-250 ml, capacity (ii) Beaker (iii) Thread

(iv) One holed rubber cork (v) Glass-tube bent twice at right angles

(vi) Small bottle (4 cm × 3/4 cm) (vii) Gram seeds/Moong seeds/Wheat grains

(viii) KOH-pellets (caustic or potassium hydroxide)

26.2 HOW TO PERFORM THE EXPERIMENT

(i) Take about 25 g of gram seeds and soak them overnight in 1/2 a beaker of water.

(ii) Next day decant the water and wrap the seeds in a wet cloth.

(iii) After one or two days, open the cloth and look at the seeds.

(iv) The seeds would have sprouted or germinated (that is the radicle and plumule appear)

(v) You may use the same method to germinate moong seeds and wheat grains and use them in place of gram seeds.

Material is now ready to proceed further.

(vi) Take a dry conical flask and put sufficient number of germinated seeds into it, so as to cover the base of the flask. (Two to three layers of germinated seeds).

(vii) Insert a one-holed rubber cork in the mouth of the conical flask.

(viii) Take a small test-tube and put 5 to 6 pellets of KOH (Potassium hydroxide).

Tie this small test-tube with a piece of thread and hang it as shown in the figure.

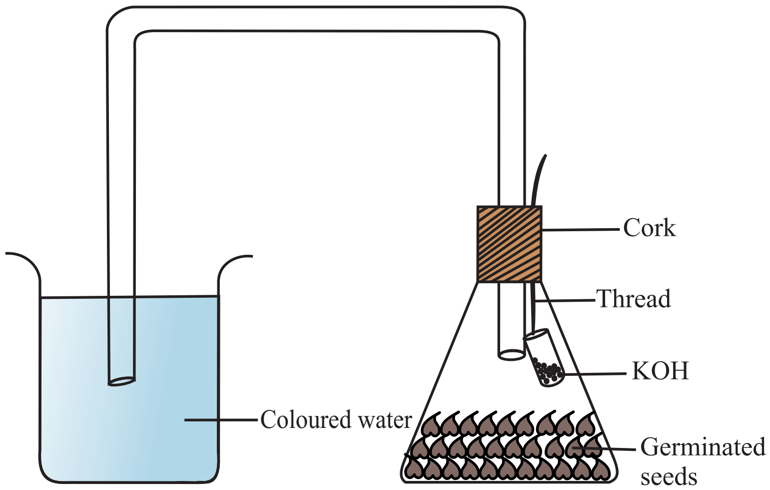


Fig. 26.1 *Experimental set-up*

(x) Introduce one end of the bent glass tube into the conical flask through the cork.

(xi) The end of the tube must be slightly away from the seeds.

(xii) Dip the other end into a beaker of water coloured with a drop of saffranin.

(xiii) Mark the initial level of water inside the tube.

Your experimental set-up is now ready for observation

(xiv) Leave your set-up and observe the level of the water after every half an hour. You will find that water level in the bent glass tube rises. This is because CO_2 released is absorbed by the KOH, and a vacuum is created in the flask. As a result atmospheric air exerts pressure and coloured water rises up in the tube.

Now turn to your work-sheet and fill in observations 1.

PRECAUTIONS

(i) The cork of the flask should be air tight.

(ii) The KOH pellets should not come in contact with the germinating seeds.

26.3 RECORDING OF OBSERVATION

Observations

(i) Why do we take germinating seeds for this experiment and not the dry seeds?

....

(ii) Can we take young floral buds instead of germinating seeds? Yes/No

....

(iii) If your answer is 'Yes', then what precaution needs to be taken?

....

(iv) Why do we take KOH pellets inside the conical flask?

....

(v) Why is the other end of the tube dipped in a beaker of coloured water?

....

(vi) Does the level of water in the tube (a) remain same, (b) rise or (c) fall?

....

(vii) State a suitable reason for your answer in Q. No. (vi)

....

(ix) Can you perform the experiment with boiled seeds? If not why not?

....

EXPERIMENT 27(i)

To Test the Presence of Starch and Fat in Given Food Samples

OBJECTIVES

After performing this experiment, you should be able to:

- *demonstrate the presence of starch in potato and some other starchy food; and*
- *check if any given food sample contains fat.*

27(i).1 WHAT YOU SHOULD KNOW

All living beings need food for their survival. Our food consists of the following food constituents - carbohydrates, proteins, fats, minerals, vitamins and water.

Starch is a complex carbohydrate present in the most commonly eaten foods such as rice, wheat and potato. Starch gives a dark blue-black colour with iodine.

Fats are the richest source of energy in our food. Besides providing energy, fats also form a part of the cell membrane of our cells. A food sample containing fats leaves a greasy transparent spot when rubbed on paper.

Material Required

(i) Test tubes (ii) Test tube stand (iii) Test tube holder (iv) Spirit lamp
(v) Iodine solution (blue tincture solution) (vi) Filter paper (vii) Funnel
(viii) Food samples (potato, grapes or any sweet fruit, groundnuts).

27(i).2 HOW TO PERFORM THE EXPERIMENT

(a) Test for starch

Cut a fresh potato into pieces. Boil these pieces in about 10 ml of water in a test tube. Cool the solution and filter it using a filter paper or a piece of muslin cloth and a funnel. The potato solution is ready. Label this test tube as A. In another test tube take distilled water and label it as B.

Experimental *Procedure*	Observations	Inference
Take about 2-3 ml of solutions A and B in two different test tubes. - Add 2-4 drops of iodine solution in each test tube.	A dark blue-black colour appears in Solution A only.	Solution A contains starch (a complex form of carbohydrate) in it.

Can you tell why solution B does not show any colour change?

(b) Test for fats

Take a food sample, such as groundnut, walnut (akhrot), cashew nut, dry coconut or a piece of butter to test the presence of fats.

Experiment procedure	Observation	Inference or conclusion
Crush a few pieces of groundnut, walnut, cashew nut, a piece of dry coconut or butter between the folds of a piece of paper. Now apply some pressure on it with the help of your thumb.	The paper shows greasy spots on it.	The food sample tested contains fat.

27(i).3 CHECK YOUR UNDERSTANDING

1. What will you observe if you put a drop of iodine solution on an unpeeled potato?

   ....

2. Why does the colour of potato solution change on contact with iodine solution?

   ....

3. If we test a solution of wheat flour with iodine, will there be any change in colour?

   ....

4. In the test for fat, what will you observe if you take a drop of kerosene instead of ground-nuts?

   ....

5. If you roast the groundnut before testing for fat, will the test for fats be positive?

   ....

EXPERIMENT 27(ii)

To Test the Presence of Adulterants in (a) Milk and (b) Metanil Yellow in Pulse

OBJECTIVES

After performing this experiment, you should be able to:

- *understand what is adulteration;*
- *detect the adulteration in some common food stuff;*
- *explain the chemical and physical basis of detection of adulterants; and*
- *become aware of the health hazards caused by common adulterants.*

27.(ii).1 WHAT YOU SHOULD KNOW

Most of the food articles which we consume, like grains, pulses, spices, fruits and vegetables etc. are given to us by nature. Many of us buy these from the market. Sometimes some other low quality, cheap, non-edible material is mixed-up in these food articles by vendors. Addition of other substances to a pure substances is known as **adulteration**. Such added material degrades the quality of food and is called **adulterant**. An adulterant may be a natural or a man made material. For example in tea leaves used tea leaves, outer coat of pulses or some colour may be added to make more profit. An adulterated food affects our health slowly and its effects can be seen after days, months or even after years. Hence, it is necessary that all of us are aware of the quality of food that we are buying. For this, we should know the common adulterants, simple tests to detect them and their harmful effects on our health.

Material Required

(i) Test tubes (ii) Test tube holder (iii) Test tube stand (iv) Spirit lamp
(v) Milk (vi) Pulses like green peas/dal, (vii) Iodine solution,
(viii) Rectified sprit (95% Ethyl Alcohol) (ix) Concentrated hydrochloric acid and
(x) Nitric acid.

27(ii).2 HOW TO PERFORM THE EXPERIMENT

Take some milk, dal and peas from your kitchen

Perform the test given below to check for presence of adulterant like metanil yellow in pulses and arrowroot or blotting paper in milk.

1. Pulses/ Dal/ adulterated with Metanil yellow

Take two spoon fulls of Arhar Dal and soak in lukewarm water for 15 minutes. Any added colour gets extracted. Similarly extract colour from adulterated turmeric by shaking in lukewarm water in a test tube. Add a few drops of concentrated hydrochloric acid to the test tube with soaked dal or turmeric. Magenta colour appears if metanil yellow is present as an adulterant. Magenta color persists even when diluted with water. You can do a control experiment by taking arhar dal or turmeric from your home and repeat the procedure given above. No colour will be seen in the unadulterated sample.

Principle: Metanil yellow is a water soluble acid based dye. On adding HCl, there is a change in pH, magenta colour appears which presists even when diluted with water. Harmful effect: consumption of food adulterant with Metanil yellow leads to degeneration of reproductive organs.

2. Milk adulterated with arrowroot or blotting paper

Boil 3 ml of milk in which arrowroot or blotting paper is added in a test tube. Cool it and add 2-3 drops of Iodine solution. The colour in the test tube changes to blue black due to the presence of starch which is present in blotting paper or arrowroot. You can do a control experiment by taking 3 ml. of milk from your home and repeat the procedure given above. Iodine does not turn blue black.

Given below is a table. Write some simple tests for detecting different adulterants in various food items. You could perform them yourself.

Table 27(ii).1 Simple tests for detecting adulterants.

S.No.	Food	Adulterant	Method of detection
1	Tea Leaves	Iron filings	Easily separated using a magnet over surface of tea spread out on a sheet of paper.
2	Tea	Artificial colour	Put the tea leaves on a moistened blotting paper. Artificially dyed tea will impart colour to the moistened blotting paper immediately.
3	Honey	Sugar solution	A cotton wick dipped in pure honey when lighted burns smoothly. If water is present it will not allow the honey to burn. Even if it does, a cracking sound is produced. (the test is for water which is there in the sugar solution added as an adulterant to honey). Also if such honey is refrigerated, sugar crystals precipitate out indicating adulteration.

4	Ghee	Vanaspati	Take one tea spoon-full of completely melted sample in test-tube and add 5 ml concentrated hydrochloric acid. Shake for 5 minutes; add a pinch of sugar and one drop of furfural. Appearance of pink colour in the acid layer indicates added *vanaspati.*
5	Sugar	Starch	Mix sample in the test tube with water, add a few drops of iodine solution. Blue colour indicates the presence of starch.
6	Sugar	Chalk Powder	Take some sugar in a test tube and add dilute hydrochloric acid. Effervescence indicates the presence of a carbonate.
7	Turmeric	Metanil yellow (arficial colour)	Extract colour from turmeric sample by shaking it with lukewarm water in a test tube and add a few drops of concentrated hydrochloric acid. A magenta colour indicates the presence of metanil yellow.

27(ii).3 CHECK YOUR UNDERSTANDING

1. What is an adulterant?

   ....

2. If grains of a cheap variety of pulses are mixed with costly pulse grains, would you call it adulteration? Give reason for your answer.

   ....

3. How can you help your mother to test the presence of coloured dye in dal.

   ....

4. Name the agency that provides certificates of reliability to food manufacturers?

   (Answer: Bureau of Indian Standards)

   ....

EXPERIMENT 28

To Estimate the Level of Pollution in Terms of Particulate Matter by Comparing Leaf Samples Collected from Different Areas

OBJECTIVES

After performing this experiment, you should be able to:

- *compare the level of particulate matter in the air in any two (or more) areas;*
- *identify the source of a particular pollutant like carbon soot in the surroundings; and*
- *conclude that CNG is a clean fuel.*

28.1 WHAT YOU SHOULD KNOW

Air pollution may be caused due to gaseous or particulate pollutants. Any fine fibres of hay, wool, cotton and particles of dust, asbestos, cement etc are examples of particulate pollutants. Entry of particulate matter in the environment above a certain level is harmful to both animals and plants. Particulate pollutants in human beings lead to respiratory problems such as allergic reactions, asthma and bronchitis. They settle down on plant leaves, block the stomatal openings and retard plant growth.

Particulate matter may be released from a number of sources. Carbon soot is added by burning of wood and leaves, from the exhaust of diesel engine etc.

A. To compare the level of carbon soot in air in different areas/localities

Material required

(i) Leaf samples collected from different areas/localities such as a residential area away from vehicular traffic
(ii) A well maintained park (iii) A busy road crossing (iv) A construction site
(v) A cement or asbestos based industry or from any other suitable area
(vi) Old white cotton cloth of the size of a handkerchief.

28.2 HOW TO PERFORM THE EXPERIMENT

(i) Carefully collect leaf samples from different areas.

(ii) Spread the cloth on a flat surface.

(iii) Place each leaf facing downwards (dark green side facing the cloth).

(iv) Gently press the leaf against the cloth with an outward movement of fingers.

(v) Observe and compare the imprints of various leaves.

WHAT TO OBSERVE

Compare the different leaf imprints on the cloth. Are all of them of the same shade? Does any one of them appear to be darker than the other? Do they give an idea of the level of particulate pollutants of that area? Note your observations in the table given below.

Table 28.1

Sample No.	Area of leaf collection	Shade of imprint/degree of dark coloration.

CONCLUSION

Leaves in areas that are highly polluted with carbon soot (emitted by the automobile exhaust) have more deposition of the pollutant.

B. To compare the level of emission of particulate matter from the exhaust of different automobiles

Material required

Filter paper or any coarse paper or light coloured pieces of cotton cloth (4"×4"), vaseline, petroleum jelly or grease used by motor mechanics, and long thread.

28.3 HOW TO PERFORM THE EXPERIMENT

(i) Cut and keep a piece of the material you propose to use. It will serve as the control.

(ii) Smear a thin layer of vaseline (or petroleum jelly) on the pieces of cloth or filter paper or any coarse paper..

(ii) Tie these pieces with the help of thread at the end of the exhaust pipes of a diesel truck, a diesel bus, a well-serviced and maintained car, a CNG bus, a tempo or transport carrier, an auto-rickshaw, a scooter or a motorcycle. Take permission of the owner or concerned person and let them remain tied for the whole day on any four busy vehicles.

(iii) Remove these cloth pieces/filter paper/coarse paper and observe after 24 hours.

Stick small pieces of these in your record book and write your observations and conclusions.

28.4 WHAT TO OBSERVE

Do these pieces look different from what was tied to the exhaust pipes 24 hours ago?

....

What has deposited on the greasy area of the cloth/filter paper/coarse paper?

....

Do these pieces look different from each other on the basis of particulate matter deposited?

....

Are there any samples that do not have any deposition? What does that indicate?

....

Which vehicle does not emit any particulate pollutant? As per your observation, which fuel is the cleanest one - petrol, diesel or CNG?

....

28.5 CHECK YOUR UNDERSTANDING

1. Which particulate pollutant is released by automobile exhaust?

   ....

2. Will the deposition of carbon soot on leaves of plants affect the level of oxygen in air?

   ....

3. How is it harmful to

   (a) Plants ....

   (b) Animals and human beings ....

4. Why was a thin layer of vaseline or petroleum jelly applied to the cloth tied to the exhaust pipes of vehicles?

   ....

5. What would happen if we applied water instead of vaseline or petroleum jelly?

   ....

EXPERIMENT 29

To Observe Organisms from Given Pictures or Specimens or in the Surroundings (e.g. Crop Field, a Garden, or A Nearby Pond), Classify Them as Producers and Consumers, and Construct Their Food Chains and Indicate their Trophic Levels

OBJECTIVES

After performing this experiment, you should be able to:

- *explain the inter-relationship between living organisms in an ecosystem;*
- *differentiate between producers and consumers;*
- *identify that the transfer of energy in the form of food occurs unidirectionaly;*
- *argue that food chain cannot begin without the green plants;*
- *conclude that top consumers are found at the end of food chains and maintain a balance in nature; and*
- *describe the inter-relationship between living organisms in an ecosystem which represents a definite pattern of eating and being eaten using the terms - producers, herbivores, carnivores, and decomposers.*

29.1 WHAT YOU SHOULD KNOW

- Green plants are the producers as synthesize food through photosynthesis for themselves and others.
- There are animals like the cattle and deer (**herbivores**) which feed exclusively on producers. These are called first order or **primary consumers** in the food chain
- Some other animals like the tiger and lion that feed on herbivores, are called **carnivores**. They are ranked as the **second order (secondary) consumers.** There can be food chains with three or even four orders of consumers.
- Fungi and bacteria, are the last members of a food chain. They grow on dead bodies of plants and animals, and are called **decomposers.**

This chain of relationships based on eating and getting eaten and represented by a producer, primary consumer, secondary consumer and a decomposer is called a **food chain.**

Some examples of food chains are given below:

Grass → Grasshopper → Frog → Snake → Hawk

Maize grain → Mouse → Snake → Hawk

Each step in a food chain is called **a tropic level** (food level). The organism in a particular tropic level may belong to different species in different food chains. e.g. grasshopper, cattle and grain eating birds and other herbivores represent primary consumers and occur at the second trophic level as all of them feed on plants only.

29.2 HOW TO PERFORM THE EXERCISE

A. To classify organisms as producers and consumers

Depending upon the availability of the facilities, field or laboratory procedures may be tried.

a. Field procedure

- **Crop Field**

(i) Look around a crop field, a garden or a forest area.

(ii) Identify the producers that are normally the green plants (grass, maize, pea, bhindi, etc.)

(iii) Spot some animals that feed upon these plants or their specific parts or products. These animals are the primary consumers.

(iv) Look out for some carnivorous animals that can feed upon the primary consumers. List these.

(v) Is there a possibility of these carnivores being eaten by higher carnivores which will be called the secondary consumers such as the lion, peacock, hawk etc.? List these organisms.

- **Pond**

(i) Visit a pond or a lake.

(ii) Observe and note the various forms of life present inside and around the water bodies. The most common organisms present there may include algae, protozoa, small fish, big fish, frogs, ducks and perhaps some other water birds.

(iii) Arrange their names on the basis of what they are eating or by whom they are being eaten.

b. Laboratory procedure

(i) Your laboratory may have separate pictures of a variety of animals and plants. As an alternative you can buy the locally available picture charts of animals and plants from a bookshop and cut out individual animals/plants. These may include all or some of the following and many others:

Grass, hawk, snake, mice, frog, grasshopper, grain-yielding plants, algae, etc.

(ii) Arrange the organisms/pictures of the organisms into three groups: (i) Plants (grass, any trees, etc.), (ii) **Plant eaters (Herbivore** animals – Cow, deer, etc.) (iii) **Flesh-eaters (Carnivorous animals –** lion, tiger, cat, etc.)

B. To construct a food chain

See figure 29.1 to help you construct the food chain.

(i) Select any one plant, place it at a spot on a large sheet of paper. Draw an arrow towards the right side of the picture/specimen

(ii) Select one animal from group two, which feeds on the plant selected. Place it next to the arrow and draw another arrow to the right side of this animal

(iii) Select one animal from group three which feeds on the animal selected above and place it on the right of the second arrow.

(iv) Try to make a food chain with four trophic levels as shown in Fig. 29.1 below

(v) Make as many food chains from the pictures /specimens as possible.

First food chain

Second food chain

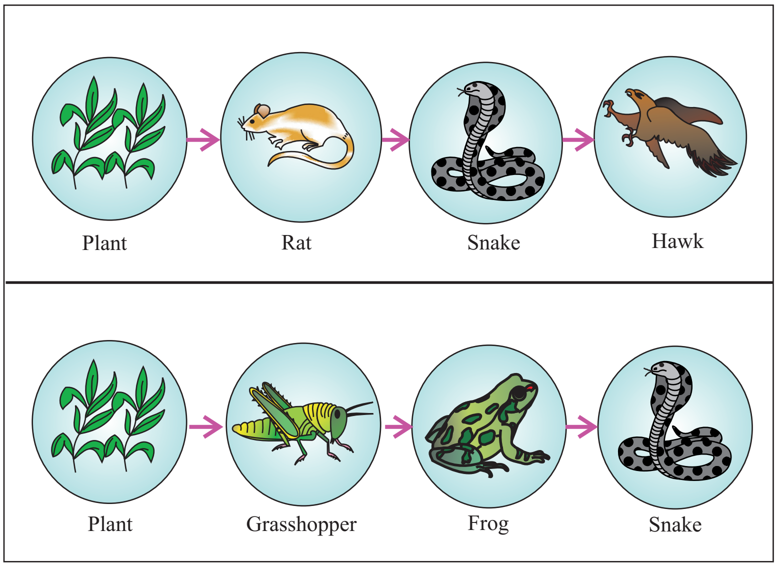


Fig. 29.1: Some examples of food chains

What was the maximum number of trophic levels in the food chain shown above?

29.3 CHECK YOUR UNDERSTANDING

1. Name the proper trophic levels (1st, 2nd, 3rd etc.) to which organisms in the following food chains belong:

   (a) Grass → Grasshopper → Frog → Snake → Hawk

   (b) Maize → Mouse → Snake → Hawk

   ....

2. Name any top consumer found in your area.

   ....

3. What may happen if all the top consumers from your area are destroyed?

   ....

4. Arrange the organisms found in your surroundings in the form of a food chain.

   ....

5. Based on their food preference, which group of animals belong to the first trophic level?

   ....

EXPERIMENT 30

To Study External Structural Adaptations in Any Two Organisms out of Cockroach, Fish, Frog, Lizard and Pigeon

OBJECTIVES

After performing this experiment, you should be able to:

- *interpret that the shape of an organism is suited to the environment it inhabits;*
- *relate the kind of locomotor- organs (legs, etc.) to the medium in which the organism moves about; and*
- *explain that the nature of skin is also an adaptation to the kind of life led by the organism.*

30.1 WHAT YOU SHOULD KNOW

- Every organism is well adapted to the conditions of the environment in which it lives.
- Some of the adaptations include the shape of the body, the type of locomotory organs (legs, etc.), the respiratory organs (whether suited to respire in water or in air), the nature of food and the kind of mouth parts (suited to nature of food preferred).

Materials required

1 Specimens

(i) **Cockroach** (freshly chloroformed or dried pinned specimen or a wet preserved specimen)

(ii) **Fish** (wet preserved specimen) or a fresh one from the market or in an aquarium.

(iii) **Frog** (wet preserved specimen)

(iv) **Lizard** (common house lizard - wet preserved specimen)

(v) **Bird** (house sparrow, pigeon or any other common bird - dry specimen)

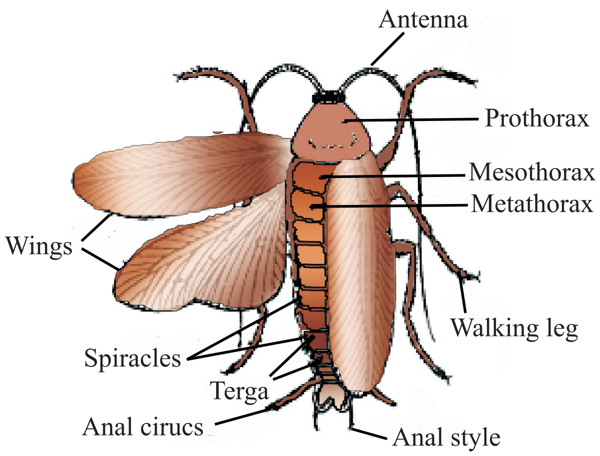
(vi) Hand lens

30.2 HOW TO PERFORM THE EXERCISE

A. Cockroach

- Cockroaches are mostly found in sewers, manholes, kitchens, food stores, etc.
- They hide in crevices and avoid light.

- When disturbed they run very fast and escape into any hiding place.
- Mature (adult) cockroaches have wings. The immature ones (nymphs) have no wings.
- Look at the specimen carefully from all sides-upper (dorsal), lower (ventral), anterior side and posterior side. Note down your observations in your record book and draw a neat diagram.



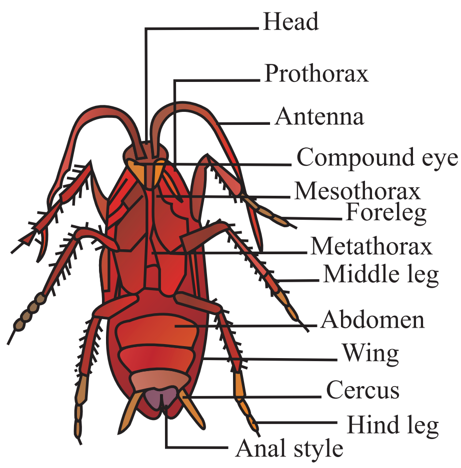


Fig. 30.1 External features of a cockroach

(i) Body shape

– Long, broad, slightly narrow towards the front and the back.

– Flattend body. This shape helps in easy creeping into holes and crevices

(ii) Body colour Reddish brown in colour. This makes the cockroach less visible in dark places, thus escaping notice of the enemy.

(iii) Body regions

Head somewhat triangular, and bent downward. It bears a pair of antennae (feelers) and a pair of compound eyes.

Thorax is the middle region which carries three pairs of legs and two pair of wings.

Abdomen is the longest region and is normally covered by the folded wings

(iv) Body parts

Locate the following parts and their special adaptive features:

- **Antennae** (also called feelers): These are a pair of long thread-like structures arising at the upper margin of the head. These are the sense organs of touch, as well as smell.

- **Legs:** There are three pairs of legs each arising from the three segments of the thorax. Each leg is a long organ formed of several joints. **Fore (front) leg** is relatively short, the **middle leg** slightly longer and the **hind leg** is longest. The slender long legs facilitate fast running.

  Examine the end of each leg with a hand lens. It bears a pair of pointed claws. The claws provide a firm hold on the surface while walking/running.

- **Wings:** There are two pairs of wings. The first pair is borne on the middle thoracic segment and the second pair on the third thoracic segment.

  If the specimen provided to you is a fresh one, gently stretch both the wings of one side (left or right) sidewards and compare their width and texture. The front wing is relatively narrower, thicker and darker. The hind wing is broader and thinner. In normal resting condition it remains folded over the abdomen and overlapped by the fore wings from above.

- **Abdomen:** It is composed of 10 somewhat flattened segments. The segments become narrower towards the hind end. The abdomen is soft and flexible, it helps in easy movements in the is hiding places.

- **Cerci** (*sing.* **cercus):** Look at the end of the abdomen. All cockroaches (male and female) bear a pair of short processes projecting out from the sides of the 9th segment. The cerci (literally meaning "tail") serve as touch perceiving organs.

- **Anal Style** (*sing*. **stylus**): In a male specimen, a pair of short rod-like processes project backward from the lower (ventral) surface of the 9th segment. These are called **anal styles**. Females have no anal style, but the underside of their seventh abdominal segment becomes broad boat-shaped for passing out the cocoon containing eggs.

Draw diagrams of the following:

1. Dorsal view of cockroach, wings of one side (preferably right) stretched out
2. One complete leg showing joints and the claws
3. Tip of the abdomen showing anal cerci and anal styles (of male).

B. Fish

There may be a variety of fish in your study centre e.g. Rohu, Hilsa, Catla, Dogfish (a kind of shark), etc: The common Rohu can be a good example.

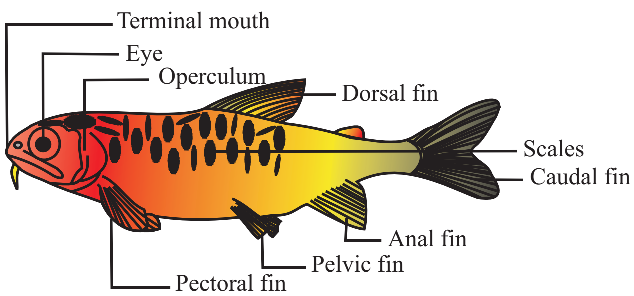


Fig. 30.2: External features of a fish

All fish live in water and swim about actively. Their external features are adapted to aquatic life.

Look at the specimen carefully. Observe the front end, the middle part and the hind end.

- **Body shape:** The body is long. It is very prominently narrow at both ends and wide at the middle. Such a shape is called stream-lined. It is most suited for movement through water, and offers least resistance.
- **Body covering (scales):** Look at the surface of the body. The skin is covered by **'scales'**. The scales slightly overlap each other and face backward. The scales are free at their hind end and lodged in the skin at the front. The primary function of scales is to provide protection against injury and attack by the germs. (Sharks have microscopic scales embedded in the skin)
- **Body regions:** The head merges into the trunk which in turn merges into the tail. There is no neck. Overall, the entire body is compact. There are no distinct body regions. This compactness facilitates movement through water.
- **Fins (paired, and unpaired)**

  Paired fins: Observe the fish carefully. Do you find any legs in the fish? No. Instead there are paired **pectoral fin** (corresponding to front legs) and the **pelvic fins** (corresponding to hind legs). Each fin is a thin sheet supported by hardened rod-like fin-rays. These fins contribute toward swimming, especially when changing direction.

  Unpaired or Median fins: Look at the tail end. It carries the large vertically flattened tail (caudal) fin. In actual life the tail fin moves sidewards contributing towards providing a forward push to the fish. The tail fin is one of the median fins.

  Two other very prominent median fins are the dorsal median fin and the ventral median fin (also called **anal fin**). Both these arise respectively from the dorsal median line at the back and the ventral median line at the belly side.

  The median fins helps in stabilizing the body during swimming.
- **Operculum (gill cover) and gills :** Look at the sides of the head shortly behind the eyes, there is an oval flap called **operculum** which covers the gills. The operculum is a movable cover. The fish gulps water through the mouth and forces it out through the space under the gill cover. The water flowing over the gills provide respiratory gases to the fish.

In case you are able to handle a fresh fish, lift its gill cover and observe the gills.

Draw diagrams of the following:

1. Side view of the fish showing all possible parts which you have examined.
2. Close-up view of any one fin showing the supporting fin-rays.

C. Frog

Frog is an amphibian (Amphi = both, bios = life). It leads life in water as well as on land. Thus it is adapted for life in both these environments. .

Look at the specimen carefully.

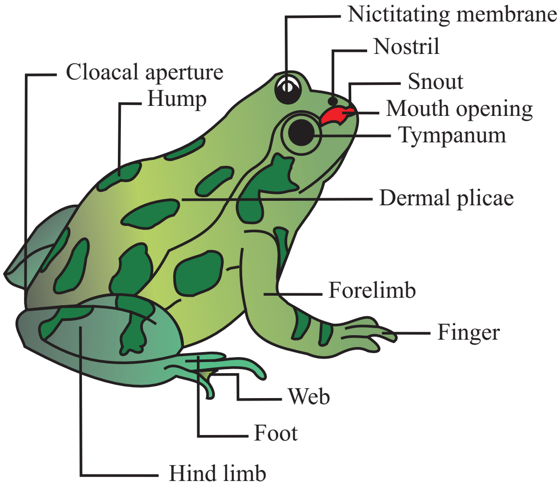


Fig. 30.3: External features of a frog

- **Body shape:** The body is rather short, pointed at the front end but somewhat blunt and broad at the back. There is no tail.
- **The skin:** Observe the surface of the skin. Are there any scales, hair or any other projecting structures on skin? No, Frog's skin is smooth. It is slimy to reduce friction while swimming in water. On land, the skin serves for diffusion of respiratory gases (skin respiration).
- **Body regions:** How many regions do you find in the body? There is a head with the snout pointing in the front. The pointed snout facilitates dashing through the water. Is there any neck? [No, any flexible neck would hinder sharp progression in water.]
- **Limbs:** Observe the front and the hind legs. Which legs are longer? Hind legs. How does the frog hold its two pairs of legs during sitting posture? The front legs are short and not much folded. They simply support the body. The hind legs are long and much folded in sitting posture. When suddenly stretched from the sitting posture, the hind legs give an upward and forward thrust. Thus, the hind legs are adapted for jumping and the front legs are adapted for providing support when the jumping frog alights on the ground.

  Observe the fingers in the fore and hind legs. There are four short fingers in the fore leg and five long toes in the foot. The toes are interconnected by a stretch of skin called **web.** The stretched toes and the webs in between act as oars for swimming.
- **Eyes**

  Examine the eyes and note that they are bulging outward. The bulging eyes give a better perception of binocular (3 dimensional) vision to facilitate capture of prey.

- **Ear**

  Does the frog have any projecting ears? No. Observe the area just behind the eyes. There is a somewhat thicker oval patch of skin. This is the ear drum (tympanic membrane).

D. Lizard (House lizard)

House lizard is a reptile. It is fully terrestrial (living on land). Look at the specimen carefully and note the following characteristic features.

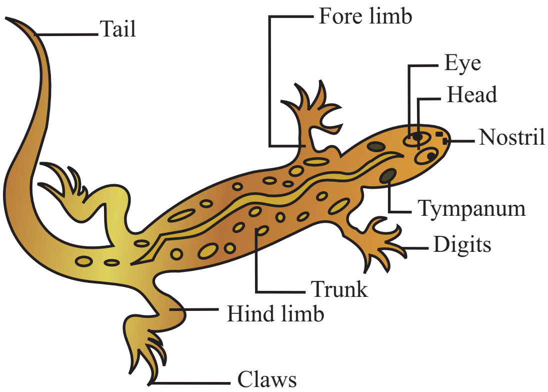


Fig. 30.4: External features of a house lizard

- **Body shape**

  The body is long and slender with two pairs of limbs (front and hind legs) and long tapering tail.

- **Body covering (skin)**

  The body is covered by a rigid dry skin. It is covered by minute scales. This kind of skin prevents evaporation of water.

- **Body regions**

  Head is clearly marked from the rest of the body. It is triangular in shape and bears a pair of large eyes, and a pair of external **nostrils** (to breathe air).

  At the sides of the head, behind the eyes, there are pair of openings leading into a deep pit. These are the **ears.**

  Neck is very prominent and is quite flexible. The mobility of the neck is very useful to the lizard as it can easily turn its head sidewards to locate its prey or the enemy.

- **Legs**

  Examine the legs. Note the number of digits in each leg. Do the fingers and toes end in claws? The claws in most lizards help in holding on to the objects.

  Examine the underside of the feet in the house lizards. Is it a uniform surface or broken into plates? The house lizard has overlapping that bear very tiny hooks or pads which provide vacuum for sticking to rough surface of the walls and roofs.

E. Bird (Pigeon/Sparrow)

Note any two features by which you can say that pigeon is a bird. It has feathers on skin and has wings for flying.

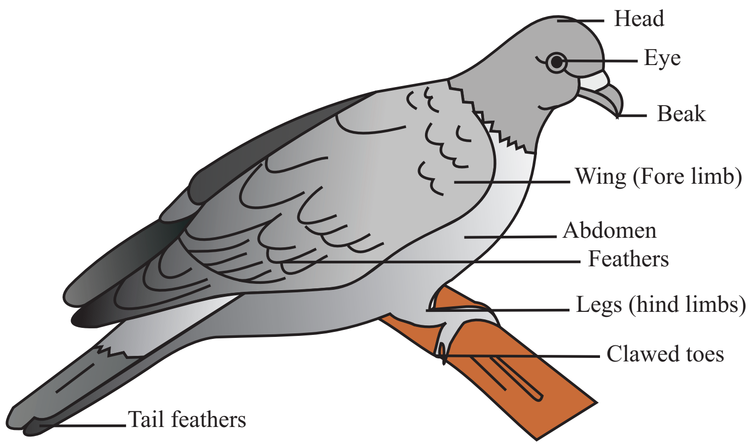


Fig. 30.5: *External features of a bird (pigeon)*

- **Body shape**

  Observe the body shape from the head up to the tail. Body is narrow in front, broad at the middle and again narrow at the back. Such a body shape is called streamlined. It helps in smooth movement while the bird flies in the air.

- **Feathers**

  Observe the structures covering the skin on the head, neck and the rest of the body. These are feathers. Are all feathers similar in size and shape? Note that the feathers on the head, neck and belly etc. are short, whereas those on the wings are long and broad. Can you think of the special functions of the feathers?

  Feathers covering the general body surface

  – provide the colour pattern to the bird.

  – provide an insulating layer to keep warm.

  – Feathers on the wings and long feathers of the tail.

  – provide an increased striking surface during flight.

  – help in steering and braking during flight.

- **Head:**

  Observe the beak and the eyes. The beak is pointed. It has the upper and lower parts corresponding to the jaws. There are no teeth. Absence of teeth is a kind of adaptation for making the body light. Crushing of swallowed food takes place inside the food canal.

- **Wings:** If there is any such specimen in your laboratory, in which a wing is stretched out, see its details. The main long part of the wing is narrow, and the long flight feathers are arranged almost in a row. [Wings are the modified front legs or fore limbs].
- **Legs**: Observe the two legs. They are short and slender.

  Note the number of toes in each of these legs - three are pointing forward and one pointing backward. How is this arrangement of toes helpful to the pigeon? It supports the weight of the body easily.

  Look at the tip of each toe. It has a strong sharp claw. The claws help in holding on to the resting surface, especially while sitting on the twigs. Claws also help to grasp the prey.

30.3 CHECK YOUR UNDERSTANDING

1. Mention the special body features of frog for the following activities:
   (i) Resting (sitting) on land...
   (ii) Swimming in water...
   (iii) Respiration in water..
2. What are the adaptive external characteristics of the house lizard-for the following. (i) to prevent evaporation; (ii) for moving about; (iii) for sticking to the walls.
3. How do the following serve as adaptations to flight in the bird?
   (i) Shape of the body...
   (ii) Feathers on body...
   (iii) Feathers on wing and tail..
   (iv) The toes and claws..

NOTES